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'Knowledge is proud that he has learned so much,
Wisdom is humble that he knows no more.'—COWPER.

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Hygiene.

BY ALFRED CARPENTER, M.D., M.R.C.P. (LOND.).

HOW TO PREVENT DISEASE IN SCHOOL AND HOME.

Infectious Wards (*continued*).—Slops should be disinfected by mixing them with equal quantities of a solution of green copperas in water, one pound of the salt being dissolved in nine gallons of water, and the w.c. and utensils washed down with some of the solution every time any slop and other waste is thrown down the waste-pipe. There must be arrangements for a bath with both hot and cold water laid on, and constructed of such material as shall not be chemically acted upon by the solution of green copperas. A portion of that salt, dissolved in water, should always be mixed with the dirty water after the bath has been used, and before the waste-pipe is opened. There must be an abundant supply of boiling water at hand in the nurses' rooms, so that all clothes which will not be injured by a temperature of 212° F. may be plunged into it before they are removed from the ward. Everything brought into the ward should be so treated, if possible, before it is taken away again, and any clothes which cannot be so treated should be reserved for treatment in a disinfecting chamber before they are taken away from the building. There should be a properly constructed clothes' basket into which unwashable wearing apparel and other articles can be put as soon as they cease to be used, by means of which they may be carried to the disinfecting chamber without danger to the carriers. No visitors should be allowed in the infectious wards under any circumstances, except when there is danger to the life of the patient. Then it is, of course, permissible for relatives to be with them, under restrictions as to intercourse with other people before they have been disinfected after leaving the building. These restrictions will vary according to the nature of the infectious disease itself. There are, however, some general directions to be observed which apply to all kinds of maladies.

No person should enter an infectious ward after long abstinence from food. It is safest to go there with a full stomach. It is better not to enter when excessively fatigued, as immediately after a long and wearisome journey, but to take rest and refreshment first. Cloth and other woollen garments are more likely to absorb infective particles than linen and cotton. A properly-constructed kind of overall should be kept in the anteroom of every ward for the protection of visitors; it should be made of washable material, something like to the bernous of the Arab, with a hood to cover the head, so that no part of the ordinary dress or the hair may be the means whereby contagion particles might be conveyed away from the building. Mrs. Priestly has suggested a very excellent garment for the purpose, which was shown at the Health Exhibition. It is to be put on before entering the ward, and removed after leaving it. Every person should wash the hands and face after the visit, in water containing a little Condy's fluid, so that every chance of carrying away infective matter may be guarded against, and even the shoes should be attended to, though Nature provides a good remedy in the action of garden mould and other earthy material. It seems as if the contagion particle cannot fructify in the presence of ulmic acid, and other products of change of organic matter, which are contained in the ordinary crust of the earth. Every one leaving an infectious ward should walk in the fresh air for at least ten minutes before entering another house, and, if possible, avoid intercourse with young children for some time. Some chemists are of opinion that green copperas and Condy's fluid are not the best germicides. I find them answer best, and shall continue to use them.

Small-pox Wards.—There is every possibility that the germs of disease coming from small-pox patients have a persistent as well as a fugitive or unstable form. In the one case the germ is like a seed, and as long as it does not commence to fructify may be preserved, and grow when transported to another place. The other is a growing atom, which rapidly dies if it be not fed by its proper pabulum. Such are the germs which escape from the air-passages of feverish patients. They must be transplanted immediately on to the mucous membrane of some one else, or they fail to grow and multiply; for these kinds of germ, a free and continuous ventilation is death to them, and safety to the neighbourhood. This kind is killed by pure atmospheric air, and by light. It is the germ by

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which an epidemic is rapidly scattered through a district from another case when numbers have become infected by a single case at the same time. It is the means whereby persons entering into a small-pox ward are at once infected if they are susceptible of the disease, for the germ is sprouting, so to speak, and ready to take root and grow in its new home. The persistent form of germ is like to a seed not yet growing. It may be carried from place to place in the scab and in the excreta derived from the patient, and its capacity to fructify will depend upon its finding a 'forcing pit' in which it may be propagated before its vitality is destroyed. The forcing pit is the mucous membrane and blood of a person liable to infection. I have known cases of small-pox arise three years after the removal of a preceding case from the spot in question, under such circumstances as rendered it perfectly certain that the germs had laid dormant during that time. The true measure to prevent this result is to destroy all débris from small-pox cases by fire—to consume the scabs and the material which has been in contact with such cases in a furnace. The flock beds and straw mattresses upon which such cases have been nursed should be burnt when the case is removed. Any building which has been used for nursing small-pox cases must be so constructed that the scabs or débris from a patient shall not be capable of being hidden away in any crevices or crack, or upon any article of furniture or appliance in the room. If the constructor of an infectious ward will bear these facts connected with the natural history of the disease in mind, he will understand the reasons for such extra care in the construction of the floor, as well as in the arrangements for the introduction of light and air. So, also, the attendants must keep in mind the possibilities of spreading the disease in the neighbourhood, even by the nurse dusting the apartment and then shaking the duster out of the window, by means of which the persistent particles may be scattered throughout a district to the great danger of all unprotected people. There is a proposal to form circular wards, which have been designed by Mr. Saxon Snell, and meets with the approval of high authority. The beds are placed in a circle, in the centre of which the fireplace is fixed, and the building is so constructed that all air which enters must pass through the fire before it leaves the apartment. This provides for the complete destruction of all floating germs, and would be a satisfactory protection to a given neighbourhood in which small-pox wards are placed. As to schools, it seems impossible to arrange that they should be provided for emergencies which may never happen, but it is right for the school authorities to be in such communication with the infectious wards of the sanitary authority, that as soon as a case does develop in the school, whether servant or scholar, that it should be removed in a proper ambulance to the infectious wards with the shortest possible delay; and no populous district should be allowed to contine without such wards being under the control of the local sanitary authority. It is a mistake to look upon such buildings as properly under the control of the destitution authority or Board of Guardians. It is no part of their duty to stamp out disease. The building and its officials should not be marked with the brand of pauperism, but belong to the authority which has to protect all classes from the effects of disease—viz., the sanitary board.

As to Nurses and Nursing.—There is always a greater difficulty in nursing small-pox wards than other sick wards, and before leaving this part of our subject we will deal with this difficulty. The nurses must have opportunities of mixing with their fellows out of doors. If it is not provided for, they will take it surreptitiously, and doing this on the sly will assuredly spread disease. The sanitary authority must face this difficulty by arranging for having such a staff that there may be opportunities every week for the acting nurses to have recreation under safe restrictions. A supernumerary nurse should always be provided who can take the place of the nurse absent on leave. No nurse ought to be on duty more than eight hours on a stretch; it is not fair, either to nurse or patient, to keep the official in the ward for a longer period than that. It must also be arranged that no meals are ever taken by the nurse in the ward itself. Food should be consumed by the nurses in their own proper room.

Whenever there is a serious case of small-pox under treatment it is absolutely necessary that two nurses be engaged in the duty of nursing, and each should be occupied for eight hours at a time. It then follows that the nights are divided equally between each. The number of nurses must depend upon the number of cases. A ward containing eight beds can be managed by one nurse, unless there are several severe cases in the ward; under the latter circumstances an assistant-nurse is required. The nurses must not be allowed to sleep in the ward, but when off duty should be out of immediate reach. It should be no part of the nurse's duty to scrub the floors or clean the grates; these duties should devolve upon some one else. Whether the wards are small-pox wards, or for any other kind of illness, wet hands and a dirty apron are not conditions which are likely to be beneficial to any patient. A nurse is liable to be called upon at any moment to assist the patient, and hands covered with black lead or grease are not comfortable to a restless and suffering or indeed to any patient. I mention these points here because it will be argued that it is necessary to limit the number of persons frequenting the infectious wards. That is so, no doubt, but there is no danger in arranging the work, and a question of £ s. d. on so small a scale should not place a risk upon the life of the sufferer, by giving the nurse work which she ought not to perform. It is the duty of the nurse to see that such things are done. It is her duty to see that the offices attached to the ward are clean and free from offensive smells, but it is not her duty to clean them down or to be occupied in things which necessarily take her attention away from her patients.

The object of the nurse is to assist in repairing the mischief which the disease is producing, and not to add to it. It is far more important in the care of the sick that the nursing should be well done. I would rather have a sensible woman as a nurse, with a do-nothing doctor, than *vice-versa*. The one directs and leaves the ward to the care of the nurse, who has to carry out orders in the absence of the medical attendant. If she is capable, she will be careful to do no harm. The nurse must be careful to see that the temperature of the ward is equable, not to allow it to be chilled, and yet not be afraid of fresh air at the proper time, to admit sunshine whenever possible, and not allow the air to become fusty or close for want of ventilation. The windows may always be opened for a short time every day unless foggy, or wet, and even

then if the walls are kept warm the room may be ventilated now and then for a few minutes without danger if the patients are protected at the time from draught. The nurse is sometimes told to keep a room at the same temperature, say at 60° F., and if the temperature is right all is supposed to be right; this, however, is not true, fresh air is of more importance than temperature, provided the walls are not allowed to be chilled. Weak patients feel cold very easily, but they suffer from impure air much more dangerously. Open the windows and shut the doors whenever the sun shines, and especially when the temperature out of doors is above 60° F. The nurse must not air damp things at the fire; all clothing should be thoroughly dry before it is brought into the ward. Smoking chimneys should not be permitted in a sick ward, so it is the nurse's duty to look to the fire to see that it is properly kept up, and not allowed to go down too low. She must also be careful to see that the effluvia from excreta is removed by ventilation, and rapid cleanliness when such conditions arise. No chamber utensil should be allowed to be in use without a lid. These should always be of earthenware, not of wood. Fumigations are sometimes practised for the removal of smell, such as burning brown paper. It was said by an eminent therapeutic lecturer that disinfectants were of the greatest utility because they made such an abominable smell in the room that you were obliged to open the windows in self-defence to let out the odour, and so ventilation was provided for. This is not always possible. It will be found in practice that the most grateful way of fumigating is by burning a tablespoonful or two of ground coffee upon a few live coals held on a fire shovel, so that the odour of the burning berry permeates the room. It ozonises the atmosphere and destroys the smell most efficiently. Some people are much afraid of night air. This is a mistake; it is much better to get the air from outside than from the basement of the house. If we could have our bedroom windows open at night we should have a marked diminution in the number of tubercular cases of disease in our midst. It is difficult to arrange when the head of the bed is near to the window. It would be an advantage much greater than the disadvantages, unless the patient sleeps too close to it, in which case it is inadmissible.

(To be continued.)

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Easy Steps in Trigonometry.

BY REV. A. D. CAPEL, M.A.,

Author of 'Catch Questions in Arithmetic,' etc., etc.

ANSWERS AND HINTS TO SOLUTIONS.

CHAPTER I.

1. Sin BAD$=\frac{BD}{BA}$; cos BAD$=\frac{AD}{BA}$; tan BAD$=\frac{BD}{AD}$; cot BAD$=\frac{AD}{BD}$; sec BAD$=\frac{BA}{AD}$; cosec BAD$=\frac{BA}{BD}$.

2. Let CAB be an acute angle x; in CA take any point P, and from it draw PN perpendicular to AB. With centre A distance AN, describe circle NP'D, cutting CA in P', and draw P'N' perpendicular to AB. From A draw AD at right angles to AB, meeting circle in D. From P' draw P'n perpendicular to AD. Then covers $x=1-\sin x=\text{rad}-\text{P'N'}=\text{rad}-\text{A}n=n\text{D}$; but $n\text{D}=1-n\text{A}=1-\cos\text{PAD}=1-\cos$ (complement of x)=vers (complement of x ∴ covers x=versed sine of the complement of x.

3. With a figure as drawn in last answer. From D draw Dt perpendicular to AD, cutting PA in t. Then tD=cotangent of x, and tA is the cosecant of x.

4. Using figure as of Paragraph 3. If $\sin x$ or $\frac{PN}{PA}=\cos x$ or $\frac{AN}{PA}$; PN=AN. And ∴ angles NAP, NPA are equal, and ∴ each equal to half a right angle.

5. Express cosine in terms of the sides of the right-angled triangle, and divide both numerator and denominator by perp.

6. Express covers x in terms of $\sin x$; apply Formula 4, viz., $\sin x=\tan x\cos x$; and express the cos in terms of its reciprocal, etc.

7. Express vers x in terms of $\cos x$. Multiply and divide by $1+\cos x$. Apply Formula 1, and divide both numerator and denominator by $\sin x$; and, lastly, apply reciprocals an l Formula 5.

8. Cos $x=\sqrt{1-\frac{9}{25}}=\frac{4}{5}$, hence tan $x=\frac{3}{4}$.

9. Expand, collect, and apply Formula 1.

10. Resolve into factors. Apply Formula 1, to eliminate one factor. Add and subtract to the other factor $3\sin^2x\cos^2x$, and again apply Formula 1, squared.

11. If AD be the perpendicular from vertex of triangle t base, BD=1; and AD$=\sqrt{4-1}$ or $\sqrt{3}$.

$$\sin\text{ABC}=\frac{\sqrt{3}}{2};\ \cos\text{ABC}=\tfrac{1}{2};\ \tan\text{ABC}=\sqrt{3}.$$

$$\cot\text{ABC}=\frac{1}{\sqrt{3}};\ \sec\text{ABC}=2;\ \operatorname{cosec}\text{ABC}=\frac{2}{\sqrt{3}}$$

$$\text{vers ABC}=\tfrac{1}{2};\ \text{covers ABC}=\frac{2-\sqrt{3}}{2}.$$

12. Apply reciprocal and Formulas 2 and 4.

13. If $\cos x=\frac{8}{17}$; $\sin x=\sqrt{1-\frac{8^2}{17^2}}$, or $\frac{15}{17}$; $\operatorname{cosec} x=\frac{17}{15}$; $\cot x=\sqrt{(\frac{17}{15})^2-1}$, or $\frac{8}{15}$.

14. Covers $x=\frac{1}{3}$; $\sin x=\frac{2}{3}$; $\cos x=\sqrt{1-\frac{4}{9}}$, or $\frac{5}{3}$. ∴ $\tan=\frac{2}{5}$.

15. Since the base must be less than the hypotenuse, the tangent must be greater than the sine of the same acute angle.

16. $4\sin x=3\cos x$. Square—apply Formula 1 to the sine. Hence $\cos x=\frac{4}{5}$ and vers $x=\frac{1}{5}$.

17. This is not easy. $\operatorname{Cosec}^2x=9\tan^2x$. Apply reciprocals and Formula 4. $\frac{1}{\sin^2x}=\frac{9\sin^2x}{\cos^2x}=\frac{9\sin^2x}{1-\sin^2x}$. ∴ $1-\sin^2x=9\sin^4x$. ∴ $\sin^2x=\frac{\sqrt{37}-1}{18}$, or $\sin x=\frac{1}{3}\sqrt{\frac{\sqrt{37}-1}{2}}$

18. Express the sine as a cosecant and the cosine as a sine; resolve into factors and apply Formula 4. This will give the required numerator; the denominator is easily reduced.

19. Apply Formulas 5 and 3.

20. Square the left-hand member under a radical. Apply Formula 1, and multiply and divide by sec x.

21 and 22. These are very much like 20.

23. Apply Formula 4, and then reduce by Formulas 1 and 2.

24. Express as a cosine, and multiply and divide by sec x.

25. Resolve into factors, and apply Formula 3.

26. Reduce by reciprocals, add, and apply Formula 1, and reduce back by reciprocals.

CHAPTER II.

1. 39ᵍ 8' 51·84". Ans.

2. 22° 47' 33". Ans.

3. Let the two angles contain $x°$ and x^g respectively, but $x^g=\frac{9}{10}x°$. And $x°+\frac{9}{10}x°=90°$. ∴ the angles are 47$\frac{7}{19}$° and 47$\frac{7}{19}$ᵍ or 42$\frac{12}{19}$°. Ans.

4. One of the angles of a regular hexagon contains $\frac{(12-4)100^g}{6}$ or $\frac{400^g}{3}$. One of the angles of a regular pentagon contains $\frac{(10-4)90}{5}=108°$. $\frac{400}{3}-108$, $=25\frac{1}{3}$. Ans.

5. 22° 57'. Ans.

6. We must remember Euc. III. 22. Let $x°$=first angle and $y°$ the second, then $x°$, $y°$, $(180-x)°$ and $(180-y)°$ are the four angles; and these, multiplied by 1, 2, 3, 4, become x, $2y$, $540-3x$, $720-4y$. But since these are in A.P. $2y-x=540-3x-2y$ (I.) and $540-3x-2y=720-4y-540+3x$ (II.), from which equations we can find x and y to be each of them 90°. Hence the figure must be a rectangle.

7. Let $2x$ and $3x$=No. of sides in the two polygons, then $\frac{(4x-4)100}{2x}=\frac{(6x-4)90}{3x}$, which will give us $x=4$, or sides are 8 and 12.

8. $45° = \frac{1}{2}^g$ of $45^g = 50^g$; and 50^g is half a right angle, hence the base is = perpendicular, and the sine is = cosine.

9. $30° : 75° = 1 : 3$. $\frac{1}{3}$. Ans.

10. $20 : 1 = 66\frac{2}{3}^g : 3\frac{1}{3}^g$. $3\frac{1}{3}^g$. Ans.

11. $64^g\ 52'\ 67''$. Ans.

12. $63^g\ 31'\ 11{\cdot}1''$ Ans.

13. Since the hypothenuse must be greater than the perpendicular, the former can never be contained once in the latter.

14. 2. Ans.

15. Let x = No. of sides. We have this equation to find x. $(2x-4)90° = [240 + (x-1)5]\frac{x}{2}$, whence $x = 16$ or 9.

16. See 13.

17. If the perp., with regard to an angle, is greater than the base, the angle is greater than its complement, hence greater than 45°.

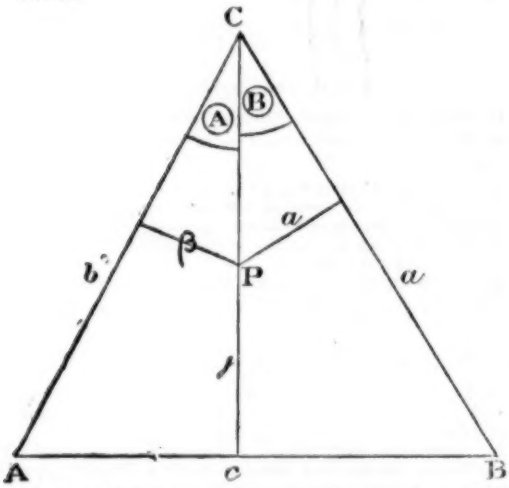
18. A figure will prove this.

19. Each angle contains $\frac{9}{10}$ of $\frac{1}{2}$ of $(200-20)$, or 81°.

20. 10,000. Ans.

CHAPTER III.

EXPRESSING LINES IN TERMS OF OTHER LINES BY MEANS OF RATIOS. DRAWING ANGLE FROM A GIVEN RATIO.



38. Let CAB be an acute-angled triangle, and let CF be drawn perpendicular to AB. From P (any point inside this triangle), which we have here taken in CF, draw perpendiculars to the sides.

39. Let us consider that the three angles, A, B, C, contain respectively A, B, C, angular units, and let us call the sides respectively opposite to them a, b, c, when a, b, c, represent the number of linear units they respectively contain; and let a, β, γ, be the lengths of the perpendiculars from a point P, on the sides a, b, c, respectively, measured by means of the same linear unit as the sides.

40. Since the angle FCB is $= 90° - B$, it is the complement of B; this I mark in the figure thus (B); similarly ACF is the complement of A, and is marked thus (A).

41. Since $\frac{CF}{b} = \sin A$; $CF = b \sin A$. Or again, $\frac{PC}{a} =$ cosec complement of B. Or $PC = a \sec B$.

But $\frac{PC}{\beta} =$ cosec complement of A, or $PC = \beta \sec A$. Equating these values of PC, we have $a \sec B = \beta \sec A$, or $\frac{a}{\cos B} = \frac{\beta}{\cos A}$, or $a \cos A - \beta \cos B = 0$.

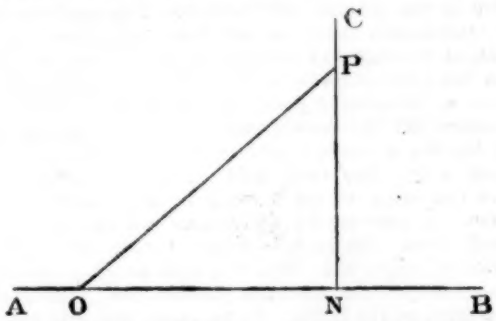
42. In 41 we have found the relationship existing between the perpendiculars from any point in CF on to the sides of the triangle. Did we know the actual lengths of a and β we could, of course, exactly mark the point P; but the relationship $a \cos A - \beta \cos B = 0$ is true with regard to every point in CF and is called its equation.

43. $a = 0$ would evidently represent a series of points from which the perpendicular distance to CB or a is always 0, and this can only represent the line CB itself; hence we call $a = 0$ the equation to CB Similarly $\beta = 0$ is the equation to CA; and, lastly, $\gamma = 0$ is the equation to AB.

44. If we were to draw AD perpendicular to BC, we could similarly show $\beta \cos B - \gamma \cos C = 0$.

45. The straight line represented by $a \cos A - \beta \cos B + \beta \cos B - \gamma \cos C = 0$ must be a straight line passing through the intersection of the two lines $a \cos A - \beta \cos B = 0$, and $\beta \cos B - \gamma \cos C = 0$: but this line is $a \cos A - \gamma \cos C = 0$ (since the $\beta \cos B$ and $-\beta \cos B$ cancel one another), which is the perpendicular from B on CA. Hence the three perpendiculars from the angular points to the opposite sides of a triangle meet at a point—as can be proved by pure geometry.

46. If we know the sine of an angle to be (say) $\frac{2}{3}$, we can draw the angle thus:—



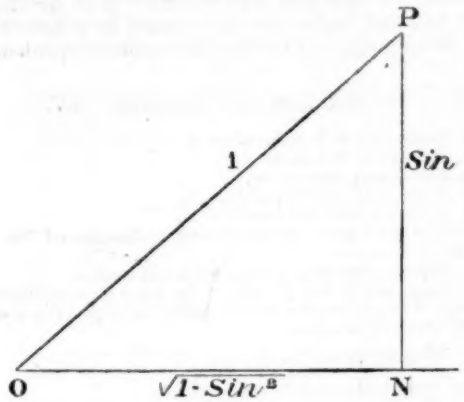
Let AB be a straight line. In it fix a point N, and draw NC at right angles to AB. Cut off NP = 2 linear units. From centre P and distance 3 linear units describe a circle, cutting AB in O. Join PO. The sine of angle PON is $= \frac{2}{3}$ or $PON = \sin^{-1}\frac{2}{3}$.

47. This notation, $\sin^{-1}\frac{2}{3}$, is called the inverse notation, and is of great use. If the student can once fix in his mind the idea that $\sin^{-1}\frac{2}{3}$ represents an angle, he will have no difficulty with it. Some writers try to explain the notation thus. Imagine the expression, sin A, capable of resolution into its parts sin and A. If, then, $\sin A = a$, $A = \frac{a}{\sin}$, or $\sin^{-1}a$, but this is only accidental, just as $2 + 2 = 2 \times 2$ is an accidental identity, inapplicable to any other numbers. If the sin, cos, etc., could be separated from the angle, we should have $\frac{\cos 2A}{\cos A} = \frac{2A}{A} = 2$, which we know it can't be. Later on, we shall give the rationale of the notation.

48. To draw the angle from its cosine, say $\frac{a}{b}$, using the same figure as in 46. Fix the point O. Measure ON a units on OB. Draw NC at right angles to AB. With centre O and radius $= b$ units describe a circle, cutting NC in P. Join PO. Then $PON = \cos^{-1}\frac{a}{b}$, or $\cos PON = \frac{a}{b}$.

49. The drawing of an angle, whose tangent is given, is left to the student.

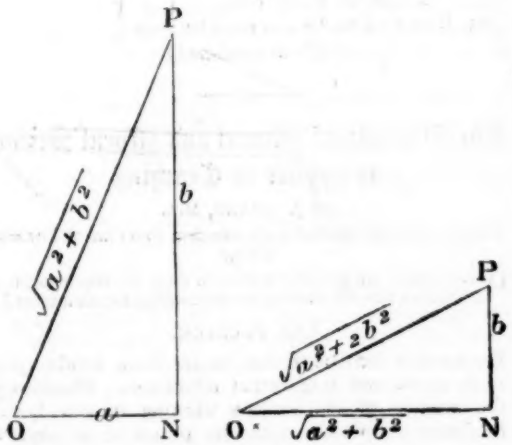
50. If we consider the consequent of any one of the goniometrical ratios to be unity, the antecedent will be the measure of the ratio. We can then express the third side of the right-angled triangle in terms of the ratio, and thence write down all the other ratios in terms of the one treated with.



Let PON be any angle x. If we take PO as our unit, PN measures the sine, and ON is $= \sqrt{1-\sin^2 x}$; hence we can write down all the ratios in terms of the sine. Thus, $\cos x = \sqrt{1-\sin^2 x}$ $\tan x = \dfrac{\sin x}{\sqrt{1-\sin^2 x}}$ $\sec x = \dfrac{1}{\sqrt{1-\sin^2 x}}$, etc., etc.

51. Similarly, if we took ON as our unit, PN would measure the tangent of the angle PON, and $\sqrt{1+\tan^2 x}$ would measure OP.

52. In such examples as, Find the value of $\cos \tan^{-1} \sin \cot^{-1} \dfrac{a}{b}$.



First draw a triangle PON, of which ON is $= a$, and NP $= b$, then OP $= \sqrt{a^2+b^2}$.

$\therefore \sin \cot^{-1} \dfrac{a}{b} = \dfrac{b}{\sqrt{a^2+b^2}}$

Now, again, draw another triangle, PON, of which PN is $= b$, and ON $= \sqrt{a^2+b^2}$; since we want to find the cosine of the angle of which the tangent is $\dfrac{b}{\sqrt{a^2+b^2}}$. PO in this case is $= \sqrt{a^2+b^2+b^2} = \sqrt{a^2+2b^2}$.

$\therefore \cos \tan^{-1} \sin \cot^{-1} \dfrac{a}{b} = \cos \tan^{-1} \dfrac{b}{\sqrt{a^2+b^2}}$

$= \dfrac{\sqrt{a^2+b^2}}{\sqrt{a^2+2b^2}}$

Note.—The student is advised to put the measures of the lines by their sides, when he will find these problems very easy.

53. EXAMINATION AND EXAMPLES.—III.

1. Let ABC be an acute-angled triangle, and let DEF be the middle points of a, b, c. If from P, a point in AD, perpendiculars β and γ be drawn to AC and AB. Prove $\gamma \sin C = \beta \sin B$; and hence write down the equations to the lines BE and CF.

2. Prove that the three straight lines which bisect the angles of a triangle pass through a point.

3. In BC (same triangle) take D so that DC = 2 BD. Find relationship between β and γ perpendiculars from any point in AD.

4. Let ABC be an acute-angled triangle, of which the angle B is greater than the angle C. From D, the middle point of BC, let DE be drawn perpendicular to AC, meeting AC in E, and from E let EF be drawn perpendicular to AB, meeting it in F. (i.) Express ED in terms of a and C. (ii.) Express EC in terms of a and C. (iii.) Hence find an expression for AE. And (iv.) prove $EF = \frac{1}{2}$ (2b sin A − a sin A cos C.)

5. Join BE (Fig. to Ex. 4). In it take any pt. P, and let α and γ be the perpendiculars on a and c,

Prove α (2b sin A − a sin A cos C) = γ a cos C sin C.

6. Using same triangle as in Ex. 4, from A draw AD perpendicular to BC, meeting BC in D. Obtain 2 expressions for AD in terms of the sides and angles. Equate and prove

$$\frac{\sin A}{a} = \frac{\sin B}{b}.$$

7. Using Fig. of Ex. 6, obtain expression for BD and DC, and prove a = b cos C + c cos B.

8. From Ex. 7 write down similar expressions for b and c. Multiply these three identities by a, b, c respectively. Add and subtract, and prove $\cos A = \dfrac{b^2+c^2-a^2}{2bc}$.

9. Write down expressions for cos B and cos C in terms of their sides.

10. Obtain formula proved in Ex. 8 from Euclid II. 13.

11. Draw the angle whose sine is $\frac{3}{5}$, that is, draw the angle $\sin^{-1} \frac{3}{5}$.

12. Write down all the ratios of the angle $\tan^{-1} \frac{3}{4}$.

13. Find vers $\sin^{-1} \frac{4}{5}$.

14. Find $\sin \cos^{-1} \tan \cot^{-1} \frac{3}{4}$.

15. Draw the angle whose cosine is $\sqrt{3}$ times its sine.

16. Draw the angle whose secant is $\sqrt{2}$ its tangent.

17. The area of a triangle is $\frac{1}{2}$ its base × its altitude. Prove that the area of any triangle is $\frac{1}{2}$ ab sin C.

18. From the Formula in Ex. 17 write down the two other symmetrical expressions for the area.

19. Let ABC be a triangle. Bisect the angles B and C, and let BO, CO meet in O. Then, by Eucl. IV. 4, O is the centre of the inscribed circle. If OD (the perpendicular on BC) be the radius (r) of the inscribed circle, prove $r(a+b+c) = bc \sin A$.

20. Let ABC be a triangle. Bisect BC and AC in D and E, and draw DO, EO at right angles to BC and AC. This, by Euc. IV. 5, O is the centre of the described circle. Join OB. Find an expression for OB or R in terms of a and the angle BOD which is = A.

21. Find $\sin \cos^{-1} \frac{12}{13}$.

22. Find $\sin \tan^{-1} \cos \sin^{-1} \frac{3}{5}$.

23. Prove $\cos \sin^{-1} \cos \sin^{-1} x = x$.

24. Prove $\cos^{-1} x = \sec^{-1} \dfrac{1}{x}$.

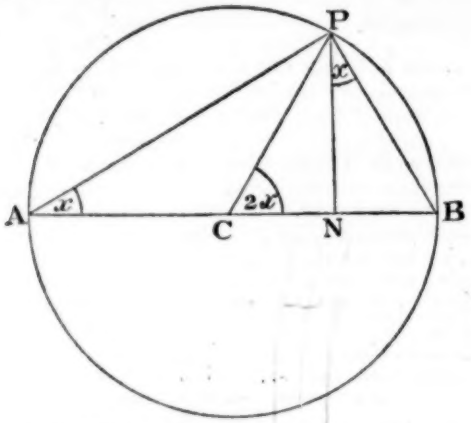
25. Draw the angle $\cot^{-1} \sin \tan^{-1} 1$.

CHAPTER IV.

DOUBLE ANGLES.

54. Let APB be a circle, of which AB is a diameter and C its centre. Let P be a point so that PCB is an acute angle. Join AP, PB, and from P draw PN perp. to AB.

By Eucl. I. 32, or Eucl. III. 20, the angle PCN is double the angle PAN.



Again, BPN = 90° − NPA = PAN.

Let PAN and BPN contain x angular units, then PCN contains $2x$ units.

55. To express the sine of $2x$ in terms of the ratios of the angle x.

$$\text{Sin } 2x = \frac{PN}{PC} \text{ or } \frac{PN}{rad} = \frac{2\ PN}{diam} =$$

$$\frac{2\ PN}{AB} = \frac{2\ PN}{AB} = \frac{2\ PN}{AP}\,\frac{AP}{AB} = 2 \sin x \cos x. \quad \text{Form. 6.}$$

Note.—In very elementary mathematics, the student has been probably trying to find factors or terms which will cancel one another. In higher subjects, he will often find that the reverse operation is resorted to, and that factors and terms, which cancel one another, are introduced—thus: we reduced

$$\frac{2\ PN}{AB} \text{ to } \frac{2\ PN}{}\cdot\frac{}{AB}$$

leaving places where some factors would be introduced, which being the same, would cancel one another. What we have to do is to find some straight line which is common to the two triangles of which PN and AB are respectively sides, and this is evidently AP.

56. To express the cosine of $2x$ in terms of the ratios of the angle x.

Using the same figure as in 54,

$$\cos 2x = \frac{CN}{rad} = \frac{CN + CN}{diam}$$

$$= \frac{AN - rad + rad - NB}{AB} = \frac{AN}{AB} - \frac{NB}{AB}$$

$$= \frac{AN}{AP}\,\frac{AP}{AB} - \frac{NB}{PB}\,\frac{PB}{AB} = \cos^2 x - \sin^2 x.$$

Form. 7.

57. To express tan $2x$ in terms of the ratios of the angle x,

$$\tan 2x = \frac{PN}{CN} = \frac{2\ PN}{CN + CN} = \frac{2\ PN}{AN - rad + rad - NB}$$

$$= \frac{\frac{2\ PN}{AN}}{1 - \frac{NB}{AN}} = \frac{\frac{2\ PN}{AN}}{1 - \frac{NB}{PN}\,\frac{PN}{AN}} = \frac{2 \tan x}{1 - \tan^2 x} \quad \text{Form. 8.}$$

58. By combining Formulæ 1 and 7, we get two very important formulæ.

$\cos^2 x + \sin^2 x = 1$ Form. 1.

$\cos^2 x - \sin^2 x = \cos 2x$. Form. 7.

Adding $2 \cos^2 x = 1 + \cos 2x$. Form 9.

Subtracting $2 \sin^2 x = 1 - \cos 2x$. Form. 10.

59. To find the value of the ratios of a single angle from that of its double, can be done from the above formulæ; but excepting in the case of the tangent, they are generally found in a way which will be shown in a later chapter, when we have discussed the signs of the ratios of angles greater than a right angle. In the collection of examples, two or three such questions will be asked, which must be worked by substituting the value given, and solving the resulting equation.

60. EXAMINATION AND EXAMPLES.—IV.

1. Express cot $2x$ in terms of cot x.
2. If $\sin x = \frac{3}{5}$, find $\sin 2x$.
3. If $\cos x = \frac{5}{13}$, find $\cos 2x$.
4. Prove $\cos^4 x - \sin^4 x = \cos 2x$.
5. If $\tan 2x = \frac{3}{4}$, find $\tan x$.
6. Find $\sin \frac{1}{2} \tan^{-1} \frac{3}{4}$ (this is only to find $\sin x$ if $\tan 2x = \frac{3}{4}$).
7. Express cosec $2x$ in terms of sec x and cosec x.
8. Show directly that the sine of the angle of an equilateral triangle is double the sine of the semivertical angle × the cosine of the semivertical angle.
9. Prove $\sin 2x = \dfrac{1}{\cot x - \cot 2x}$
10. Prove $\tan x + 2 \sin^2 x \cot 2x = \sin 2x$.
11. Prove $\tan 2x - \tan x = \tan x \sec 2x$.
12. Prove $\tan x + \cot x = 2 \operatorname{cosec} 2x$.
13. Prove $\cot x - \tan x = 2 \cot 2x$.
14. Prove $\sec x \operatorname{cosec} x - \cot x + \tan x = \dfrac{4 \sin^2 x}{\sin 2x}$.
15. Prove $2 \tan^{-1} \frac{a}{b} = \tan^{-1} \dfrac{2ab}{b^2 - a^2}$.
16. If $\sin x = a$, find $\cos 2x$.
17. If $\tan 2x = a$, find $\tan x$.
18. Prove $\tan 2x = \dfrac{2 \sin x}{2 \cos x - \sec x}$.
19. Prove $\sin 2x = \tan x + \tan x \cos 2x$.
20. Find $\sin \cos^{-1} \tan \cot^{-1} \frac{5}{12}$.
21. Find $\operatorname{vers} 2 \cos^{-1} \frac{3}{5}$.
22. Find $\operatorname{covers} 2 \cot^{-1} \frac{1}{3}$.
23. Prove $\dfrac{1 - \cos 2x}{1 + \cos 2x} = \sec^2 x - \operatorname{cosec}^2 x + \cot^2 x$.
24. Solve (in 2θ) the equation:—
$2 \cot \theta - \sec \theta \operatorname{cosec} \theta = 4$.
25. If $\cos \theta + 2 \sin \theta = \sqrt{5}$, prove $\tan \theta = 2$.

(To be continued.)

The Elements of Mental and Moral Science as applied to Teaching.

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[These articles are specially written to meet the requirements of candidates who are reading for the certificate examination.]

THE PROBLEM.

EDUCATION may be treated under three heads—physical, moral, and intellectual education. Physiology, the science of the healthy working of our bodily functions, supplies us with the principles of physical training; psychology, the study of the mind in its widest meaning, gives the basis upon which moral and intellectual education is founded. Physiology treats of matter, psychology of mind; and it may seem, since the precise relation between mind and matter is unknown, impossible to make an exact distinction between the sciences. But a very clear difference is established by observing that a physiological fact does not

imply consciousness, while consciousness is an essential factor in every phenomenon of psychology. The circulation of the blood goes on quite outside of our consciousness, and is, therefore, a physiological fact; the circulation gets out of order, and the resulting uneasiness, not the disorder itself, comes within the scope of psychology.

Most thoughtful people must have at some time wondered, with Goldsmith's villagers, at the capacity of one small head; and the teacher must go a step beyond wonder, which is but the beginning of philosophy. He must ask and seek to answer three questions with regard to each of the little heads brought within his influence:—1. What does it contain? 2. How is it related to other heads? 3. How can we make it capable of holding more?

The anatomist answers the first question by naming a certain number of organs contained in the skull, and the physiologist explains their functions. The only organ with which we are here concerned is the large mass of nerve-matter called the brain. Psychology and physiology agree in asserting that this is the seat of the mind. This merely amounts to the statement that certain changes in the brain are accompanied by certain mental phenomena, and, further, that, in a general way, certain portions of the brain are specially connected with particular forms of mental activity. Anything beyond this is misleading. Nothing is really known of the nature of the connection between mind and matter. The attempts of the phrenologist to parcel out the brain into small sections, corresponding respectively to a long list of faculties, are not only scientifically false, but practically pernicious. The teacher must be specially on his guard against being misled by phrenological 'heads' into the belief that the mind is made up of a series of independent faculties. The mind is essentially a unity, an organic whole; and the different faculties are simply different forms in which that unity acts. The mind wills, imagines, and remembers, just as a man speaks, writes, and walks; and it would be as sensible to divide man into speaking, writing, and walking, as the mind into will, imagination, and memory. The mind is one and indivisible, and these are but different aspects under which it is viewed.

The action of mind on mind is almost as incomprehensible as the action of mind on matter. In one sense, every mind is shut up within itself: we can never penetrate into the depths of each other's minds. Each is

> 'Allied to all, yet none the less
> Prisoned in separate consciousness.'

Each mind can directly know only its own acts and states. Yet by means of these it can communicate with other minds by a species of self-interpretation. Each mind knows that it reacts upon the body in a certain way only under certain stimulants. When, therefore, it finds a body like its own acting in a particular way, it infers, in the first place, a mind similar to itself, and, in the second place, similar stimulants to those which produce a like effect on its own body. A child is hungry, and cries; he sees another child crying, and at once comes to the conclusion that the latter is also hungry. Language is simply an extension of this process. When we hear a word that we know, we at once call up a corresponding idea, and when we repeat the word we believe that the same idea rises in our neighbour's mind. As a matter of fact, it is probable that any word, unless the very simplest, calls up somewhat different ideas in different minds. Yet, among people of fairly equal intelligence, the same word suggests ideas so much alike, as to enable one man to have a very accurate knowledge of what his neighbour wishes to express. In this way the one head is brought into relation with the other, and one main aim of education is to limit the meaning of each word so carefully, that the ideas it calls up in different minds may be as near as possible identical.

The third question is, perhaps, the most important for teachers. In order to assist the development of the mind, we must learn all we can of its nature: we must study psychology. It may be objected that much good work has been done by teachers who never even heard of psychology. The answer is easy. All really good teachers work upon psychological principles, whether they know it or not. The only difference is that properly trained teachers learn these principles from study, while the others gather them from practical experience, and at the expense of many classes of children upon whom they have experimented. A ship-master, ignorant of the principles of navigation, may become a good seaman after half-a-dozen shipwrecks; but half-a-dozen good ships is too heavy a price for one good seaman, if a little study can prevent such waste.

It is true that some teachers who absolutely disregard psychological principles do sometimes produce good results. But psychology can both explain this fact, and show how better results could be attained. Since the mind is a unity, all its functions are organically related to one another. One faculty, therefore, cannot be cultivated without indirectly influencing all the others. The teacher who depends entirely upon rote-work does, to a certain extent, cultivate the understanding. The child may not understand a word of what he is learning, yet he cannot learn absolutely without thought. He thinks about the length of the line, about the capital letters, about the place on the page. Often when he 'sticks' in his repetition, he goes through a process of reasoning before he can go on. He remembers what happened when he last saw this hard bit, or he recollects that the missing link is a hard word that begins with a 'p,' or some such basis, from which he seeks to reason out the context. At all events, he exercises his understanding in trying to calculate the part he will be asked to repeat. Yet most of his mental energy is spent on memory, while the other powers only get the waste force. Education demands, however, that the mind be developed all round, and not over-fed at one point and starved at another.

There are various theories as to the origin of knowledge. Locke maintained that 'all our knowledge consists in the view the mind has of its own ideas.' This statement may be accepted as true, especially in the light of his very broad definition of an idea as 'Whatsoever is the object of the understanding when a man thinks.' But his theory of the origin of these ideas is unsound. Descartes had maintained that knowledge began with certain ideas, which he called 'innate ideas,' and which the mind was born with the power of developing from within. Locke attacked Descartes from a mistaken notion of his meaning. The French philosopher did not hold, as Locke imagined, that such 'innate ideas' as time, causality, infinity, were born

ready-made with the child. He only maintained that the child was born with the power of developing these ideas apart from all outward influence.

Locke, who represents the sensational school, held quite a different doctrine. All our knowledge comes from without. The mind is passive, and is compared to a sheet of blank note-paper upon which sensation writes. We begin our mental life as empty pitchers into which ideas must be poured from without. But sensation is unequal to Locke's demands. It is true that without sensation we can form no idea of heat, or cold, or blue, or sweet. These 'ideas of sensation,' as he calls them, must certainly come from without. But if the mind be purely receptive, they can make no impression upon it. Each sensation is momentary, and has no connection with any other sensation. They pass over the mind, and leave it as they found it.

This defect is observed by Locke himself, who gets rid of it by introducing his 'ideas of reflection.' These are ideas within the mind itself, developed in some mysterious way from the 'ideas of sensation,' which come from without. The ideas of sensation, in some way that Locke does not explain, work upon each other, and then the mind begins to examine itself, to turn itself back upon itself, to see what this working means. The products of this turning of the mind back upon itself are called 'ideas of reflection.' Ideas like those of 'perception, thinking, doubting, believing, reasoning, knowing, willing,' are 'such only as the mind gets by reflecting on its own operations within itself.' He has got over the difficulty, and is now able to combine his separate sensations. But this power is gained at the expense of consistency. The mind is no longer passive. It is true that 'ideas of reflection' do not appear till sensation is in full operation, but Locke does not at all show how his blank sheet of note-paper came to be able to arrange the writing which sensation inscribes. We can accept Locke's 'ideas of sensation,' *or* his 'ideas of reflection' —they are both rational conceptions; but we cannot accept them together. He argues ingeniously for each of them, but he cannot justify their union. In fact, he does not see that the two parts of his system are inconsistent—does not see that it is necessary to give some reason why the mind, passive up to a certain point, should suddenly become active.

Kant, on the other hand, maintained that both perception (including sensation) and conception are active in the process of knowledge, and that neither is of any value apart from the other. 'Perception without conception is blind; conception without perception is empty.' That is, the perceptive faculties—those which put us into relation with the outer world —may supply us with a mass of unconnected impressions; but these do not form knowledge, unless the conceptive powers of the mind group them together and reduce them to order. On the other hand, the actively regulative, or conceptive, powers of the mind are of no avail, unless the perceptive faculties supply them with materials. Perception is as active as conception. And it was only Locke's reaction from what he supposed Descartes to mean by 'innate ideas' that led him so to exaggerate the external influence as to deny all activity to the perceptive powers. For the blank sheet of note-paper, we may substitute the photographer's prepared sensitive plate, upon which the light acts. The plate without the light, and the light without the plate, are alike powerless to produce a picture; their combined action is necessary.

Taking the empty-pitcher theory of knowledge, the teacher might content himself with merely supplying facts; and at certain stages a teacher can do no more than simply *inform*. Whatever theory of the origin of knowledge be accepted, facts must at the beginning be supplied. Still, within the Lockian lines is the process of *instruction*, or the arrangement of acquired facts, which, indeed, corresponds to an attempt to develop ideas of reflection by means of external influence. In its ordinary sense, *teaching* implies only a combination of informing and instructing; but when we come to *education*, or the drawing out of the natural powers, and *training*, or the proper moulding of the powers thus brought within our reach, we pass beyond the Lockian theory. For education does not mean merely to draw out what we put in, but what is inborn. When a teacher gives his pupil a number of facts to-day, and contrives to get them back from him in a somewhat different form next day, we have an example of teaching. But when Socrates, by well-arranged questions, got a boy to prove a proposition in geometry which the boy had never before seen, we have an illustration of education.

CLASSIFICATION OF THE MENTAL POWERS.

Recognising the essential unity of the mind, we may yet consider its various functions in their relations to each other. Viewed in this light, the mental phenomena fall under four main heads—Knowledge, Feeling, Desire, and Will. A study of the first of these is necessary to our intelligent understanding of what is usually termed intellectual education, while moral training must be based upon the results of an examination of the remaining three. Knowledge is the fundamental process of psychology, and may be roughly defined as that act of the mind in which it assimilates some object or fact with itself. From some actual object—say, a cannon-ball—we form an idea in the mind, and this is an act of knowledge. Again, we try to lift the cannon-ball, and ascertain the fact of its heaviness. There is no real object called heaviness, yet the mind makes this fact of heaviness into an idea, and we have again an act of knowledge. Certain physiological states must precede knowledge, but before knowledge there can be no true mental process. There is a theory of Latent Consciousness—that is, of mental states and actions so insignificant as to be out of the sphere of Consciousness, and therefore of Knowledge. These pre-conscious acts and states are very important in education, but they are physiological rather than psychological, and we may fairly regard Knowledge as primary.

On the other hand, Feeling is derivative, and may be defined as that state of mind which follows an act of knowledge. It also differs from knowledge in being passive and having no object, as is illustrated in the use of such neuter verbs as 'rejoice,' 'grieve,' 'exult.' It is true that fear is a feeling, and that we speak of 'fearing' an object. But the true state of the case is that we know the object, and, as a result of our knowledge, a peculiar state of the mind arises which we call fear.

As Feeling implies Knowledge, so does Desire imply Feeling. Desire is the outcome of Knowledge plus Feeling. Like Knowledge, Desire has an object. It is therefore active, but it differs from Knowledge

by possessing, in addition, an impulse to action. We perceive a beautiful picture—that is, we know the picture: the feeling of joy arises; then comes the desire of seeing the picture often, of possessing it. In the same way, we wish to avoid what gives rise to disagreeable feelings. Thus, Desire may be defined as the blind impulse to act under the influence of agreeable or disagreeable feelings.

But it is one thing to desire an object, and quite another to determine to obtain it. We may follow the blind impulse to action, or we may resist it. This power of choice between alternative courses of action is the Will. Will is thus the highest exercise of the mind, for it implies the previous existence of Knowledge, plus Feeling, plus Desire, and is that which finally determines all our actions.

Speaking generally of the mental powers, it is necessary to distinguish between capacity and faculty. A capacity is a passive power of the mind, and gives rise to 'states.' A faculty is an active power, and gives rise to 'acts' of the mind. Thus feeling is a capacity, and gives rise to a 'state' of fear, love, and so forth. Imagination is a faculty, and we speak of it as acting, instead of being acted upon.

It will not be here necessary to give a detailed analysis of the various feelings and desires, but the powers of knowledge must be examined at some length. Knowledge is exercised under the various forms of consciousness, attention, sensation, perception, conception, memory, imagination, judgment, and reasoning. Of these, the last two are exercised more or less along with all the others, and may be called the regulative powers. Of the remainder, consciousness, attention, sensation, and perception form a class by themselves called the intuitive powers. In these the mind directly grasps its object. But in the third class, or representative powers—comprising conception, memory, and imagination—knowledge is obtained by means of a mental image, which represents the real object. In perception there is an actual orange before me; in memory my mind calls up a mental picture of the orange.

The mind does not display all these functions at once. There is a gradual development. But, on the other hand, it must not be supposed that the various faculties and capacities come to maturity in an absolutely invariable order, and with mathematical precision. Different powers ripen more rapidly during the same time in different individuals, and a higher faculty begins to be developed long before any given lower faculty is mature. Thus judgment, one of the latest to be developed, is present in a rudimentary form at the very beginning of mental activity. Still, certain general laws may be laid down as to the order of development. We cannot get a clear idea of the absolutely first stage of mental activity, for we cannot remember our experience when we were in infancy, nor can we answer the poet's question:—

> 'Who can tell what a baby thinks?
> Who can follow the gossamer links
> By which the mannikin feels his way
> Out from the shores of the Great Unknown,
> Blind, and wailing, and alone,
> Into the light of day?'

We must, therefore, content ourselves with general considerations applied to this early stage.

The mind comes into being by passing from unconsciousness into consciousness. We can form no adequate conception of that state of unconsciousness which precedes the first activity of the mind. The only way in which we can picture to ourselves this primary state is by imagining a state of absolute uniformity. Consciousness takes its origin in difference, and seems to be the fundamental form of knowledge. Consciousness begins when the infant discriminates, however roughly, between light and darkness, heat and cold. The difficulty of arranging the mental powers in a hard and fast order of development is illustrated by the question which naturally arises here. 'If consciousness depends upon discrimination, it must depend upon sensation, for without sensation there can be no discrimination. Is not sensation, then, really the fundamental activity of the mind?' The answer seems to be that consciousness is a general power, and cannot exist by itself. We can only be conscious as we feel, perceive, imagine, and so forth. On the other hand, no mental state can exist without consciousness. The sleeping infant may have all the physical conditions of sensation; but without consciousness, sensation, as a psychological fact, is impossible. Consciousness and sensation, therefore, as mental phenomena, really begin together. But consciousness, as being essential to all mental activity, may be said to be fundamental.

Memory is another faculty which cannot be easily referred to a definite place in the order of development. It must appear very early, and is, indeed, implied in clear consciousness. To be conscious of a sensation is to be conscious of it as *my* sensation, and this demands previous knowledge of 'me.' I can be conscious that I continue to be the same person, only by remembering that I, who have a sensation now, had a sensation formerly. Thus memory and continuous consciousness mutually imply each other.

The next in order of development is much more definitely placed. Perception must follow sensation. The child begins to distinguish between himself and his surroundings. At first he thinks he can touch everything he sees, however remote. Soon he learns that the room is not in his eye, but outside of him altogether. This is perception. No sooner does the mind grasp the fact that certain objects exist outside of itself, than it proceeds to rude forms of generalisation, and we have conception. Thus to a young child all women are 'Ma,' and all quadrupeds are cats or dogs, according as a cat or a dog is first brought under his notice. The next faculty to be developed is imagination, and, lastly, judgment and reasoning.

The last two, though very late in arriving at maturity, are really present in a rudimentary form from the very first. The earliest discrimination between light and darkness presupposes comparison, which implies a low form of judgment. But while the mind is conscious of the result of this judgment, it is unconscious of the process, and the term 'judgment' is usually restricted to the deliberate comparison of the two objects, and the resulting assertion.

Summarising, then, we may arrange the mental powers into the following groups in order of development:—First, consciousness, sensation, and rudimentary memory and judgment. Second, perception, and along with it, feeling. Third, conception, desire, and memory. Fourth, imagination. Fifth, judgment. Sixth, reason and will. All up to and including perception are often grouped as powers of observation, all beyond as powers of reflection. This latter term,

however, is often limited to the reasoning powers, and is sometimes defined as 'a thinking upon thought.' Neither of the terms has a very definite meaning; but observation refers to our knowledge of external objects, reflection to our knowledge of acts and states of the mind.

There are no very definite laws as to the ages at which the different powers are developed. But, in a general way, it is true that a child of three years can use all his powers of observation. Between three and six conception and imagination can be clearly distinguished. Memory is at its best between six and ten. Judgment, in its exact sense, begins with the first attempts at naming objects, while reason, as a logical process, cannot be said to exist till between the eighth and tenth years. Feeling and desire follow close upon the first exercise of sensation, and, since these two lead to action, there must be the working of a rudimentary will. But since the Will proper acts according to reason, it must be of later development.

Applying these considerations to our actual teaching, we find that most schools are graded to suit the nature of the children. In the infant department, perception is almost exclusively trained, but the ball-frame and object-lessons of comparison, with the comparison necessary to distinguish among the letters of the alphabet, prepare the way for the systematic cultivation of conception. In the standards the teacher is not left to his own discretion in the choice of subjects, but his methods must be his own. It is not our province to criticise the Code, but to take existing circumstances as they are, and seek to discover the truest educational principles and the best methods of applying them. In what follows, we shall endeavour to show how the ordinary work of the school may be so regulated as to serve the highest ends of education, without any expensive apparatus or undue interference with established methods.

(To be continued.)

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Lessons in Latin.

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(*Continued from page* 8).

KEY TO EXERCISES.

EXERCISE 75.

A.

1. I laid the first foundations of (for) the city on the Palatine Hill. 2. All things that were the woman's become the husband's under the title of dowry. 3. I deem it a matter of highest honour to defend the unfortunate. 4. It is a wise man's peculiarity to do nothing which may be repented of. 5. He said it was not a fashion of the Greeks for women to sit at table in a party of men. 6. That great and destructive sink of the commonwealth, consisting of your companions, shall be drained from the city. 7. You see that all that money has been embezzled by Verres. 8. This matters no more than if you carry water to a sieve. 9. There is no one of fools blessed, no one of wise men not blessed. 10. Sauciness is rather a characteristic of youth than of old men; yet not of all youths, but of (those who are) not good.

B.

1. Habenda ratio non sua solum, sed etiam aliorum. 2. Natura tu illi pater es, consiliis ego. 3. Popillius claves portarum suae potestatis fecit. 4. Animus meus totum istuc aequi boni facit. 5. Utriusque nostrum magni interest ut te videam. 6. Elephanto belluarum est nulla prudentior. 7. Homini uni animantium luctus est datus. 8. Vivorum memini, nec tamen Epicuri licet oblivisci. 9. Res adversae admonent nos religionum. 10. Prima est historiae lex ut ne quid falsi dicere audeat, ne quid veri non audeat.

EXERCISE 76.

A.

You were not yet so great, when I, a nymph, given forth from the great river, was contented with you as a husband—you, who are now the son of Priam . . . . let personal respect be absent from truth . . . . were a slave. I, a nymph, bore (deigned) to marry a slave. Who (but I) used to show you the coverts fit for hunting, and under what rock the wild beast might protect her puppies? I, your companion, often stretched the nets, wide as to their meshes. I often drove the swift dogs through the long ridges. The beeches cut by you to preserve my names, and I, Oenone, am read, written by your sickle; and as the trunks, so my names grow. Grow on, ye names, and rise aright to tell my tale. O poplar tree, live, I pray, for thou sown on the edge of the bank hast this song in thy rough bark: 'When, Oenone having been left, Paris shall be able to breathe (that is, to live), the water of Xanthus, turned, shall run back to its source.' O Xanthus, hasten back, and ye, turned waters, run back. Paris presumed to have deserted Oenone. That day, to me miserable, spoke my fate; from that day the worst winter of changed love began, on which Venus, Juno, and the naked Minerva, made more decent by the arms assumed, came (to submit) to your judgment.

B.

1. 'Edita' is a perf. pass. part, from 'edĕre,' P. R. edid, 3rd R. edit, f. s., n., to agree with 'nympha.' 2. 'Absit,' is an intrans. verb, from 'abesse'; P. R. abfu, no 3rd R.; sub. pr., 3rd sing., to agree with 'reverentia.' 3. Dat. after 'nubere,' which is always spoken of the female, 'ducere' being the word for the male. 4. 'Saltus' is a noun of U decl.; m. pl., ac. direct obj. of 'monstrabat.' 5. 'Tegeret' is a transit. verb, of the short *e* conj., from 'tegĕre'; P. R. tex, 3rd R. tect; sub., imp., 3rd sing., to agree with 'fera.' 6. It is in the subjunctive mood, because there is a certain amount of doubt as to whether each particular rock proved the lair of a wild animal. 7. That the Latin language is an offspring from the Greek, all the latter's perfects, beginning with a consonant, being formed in this way. 8. 'Agĕre,' P. R. eg, 3rd R. act. 9. N. V. A. canes; G. canum (exceptionally consonantal); D. Ab. canibus. 10. Feminine, because constantly spoken by the unlearned, whence comes all the exceptions of language. 11. 'Nomina' understood. 12. Potero, poteris, poterit, poterimus, poteritis, poterunt. Recurram, recurres, recurret, recurremus, recurretis, recurrent. 13. 'Propera' is a verb of the *a* conj., from 'properāre,' P. R. properav, 3rd R. properat; imp. mood, P. tense, 2nd sing., to agree with 'Xanthus.' 'Recurrite' is a verb of the short *e* conj., from recurrĕre; P. R. recurr, no 3rd R.; imp. mood, P. tense, 2nd pers. pl., to

agree with 'lymphae.' 14. The scanning shows us that the *e* is long, whereas in the present the *e* is short. 15. Elegiacs—that is, the former are hexameter, and the latter a pentameter:—

Et quān | tūm trūn | cī," tān | tūm mĕă | nōmĭnă | crēscūnt : ||

crēscīte, ĕt | ĭn tĭtŭ | lōs || sūrgĭtĕ | rēctă mĕ | ōs ||.

Pōpŭlĕ, | vīvĕ, prĕ | cōr," quāe | cōnsĭtă | mārgĭnĕ | rīpāe ||

hōc ĭn | rūgō, | sō || cōrtĭcĕ | cārmĕn hă | bēs ||.

LESSON LXXVII.

RECAPITULARY.

618. VOCABULARY 77.

English.	*Latin.*		*Derivatives.*
Moreover	intĕrĕa, adv.		
To cry	clāmāre	R. clam	exclamation
Hollow	concavus -va -vum	R. concav	concave
Justice	justitia	G. justitiae	
Guardian	custos	G. custōdis	custodian
Since	quandoquidem, conj.		
To restore	restituĕre	P. R. restitu 3rd R.	restitūt
Heavy	gravis	G. gravis, I adj.	gravity
To revolt	desciscĕre	P. R. desciv	descīt
Meanwhile	intĕrim, adv.		ad interim
Messenger	nuntius	G. nuntii	Pope's Nuncio
Juncture	discrīmen	G. discriminis, n.g.	discriminate
Embassy	lĕgātio	G. legationis	legation
To admit	admittĕre	P. R. admis 3rd R.	admiss
Useless	irritus -ta -tum	R. irrit	
Fear	pāvor	G. pavōris	
To deject	percellĕre	P. R. percul 3rd R.	perculs
To become a youth	pūbescĕre	P. R. pubu No 3rd R.	
Illustrious	ēgrĕgius -a -um	R. egregi	egregious
Javelin-thrower	jăcŭlātus	G. jaculati	
Rashly	trĕpĭde, adv.		
To yield	cēdĕre	P. R. cess 3rd R.	cess
Savageness	saevitia	G. saevitiae	
To kill	interfĭcĕre	P. R. interfec 3rd R.	interfect
Of his own accord	ultrō, adv.		
Glassy	vitreus -a -um	R. vitre	vitreous
Hoar-frost	pruina	G. pruinae	
To cover	tĕgĕre	P. R. tex 3rd R.	tect
To determine	constituere	P. R. constitu 3rd R.	constitut
The neck	cervix	G. cervicis	
Complaints	questus	G. questūs	
Lamentation	lāmentum	G. lamenti, n.g.	
To soothe	permulcĕre	P. R. permuls { 3rd R.	permuls, and permulct
To repress	comprĭmĕre	P.R. compress 3rd R.	compress
To entreat	obtestari, dep.	3rd R.	obtestat
To rest	quiescĕre	P. R. quiev 3rd R.	quiet
Contest	certāmen	G. certaminis	
To lead out	ēdūcĕre	P. R. edux 3rd R.	educt
Lastly	postrēmo, adv.		
Snowy	nivālis -le	R. nival, I decl.	
Hastily	raptim, adv.		
To breathe on	afflāre	R. afll	inflate
But	vĕro, a conj.		
When	ut, conj.		
To follow	insĕqui, dep.	3rd R.	insĕcut
To fly from	rĕfŭgĕre (io)	P. R. refūg No 3rd R.	
To come out	ēgrĕdi (ior), dep.	3rd R.	egress
To be stiff	rigēre	P. R. (?) rigu No 3rd R.	
Power	pŏtentia	G. potentiae	
To be weak	dēfĭcĕre	P. R. defēc 3rd R.	defect

619. EXERCISE 77.

A.

1. Interea toto (31) clamanti litore (30) 'Theseu!' reddebant (29) nomen (20) concava saxa (38) tuum (20), et quotiens (52) ego (35) te (35), totiens (52) locus (29) ipse (40) vocabat (11). Ipse locus miserae (28) ferre (53) volebat (53) opem. 2. Meminerimus (46) etiam (69) adversus (67) infimos (49) justitiam esse (38) servandam (60). 3. Cimon nunquam (28) in hortis (8) custodem imposuit (29), ne quis (70) impediretur (59), quominus (58) eis (37) rebus, quibus (27) quisque (70) vellet (53) frueretur (45). 4. Ii (37) postquam frequentes (72) convenire (68): 'Quandoquidem,' inquit (56), 'tu (35), fili (7), contra (67) imperium (19) consulis (63) pugnâsti (43), oportet (48) ut disciplinam tuâ (20) poenâ (45) restituas.' 5. Aliquando (52) in exercitu (19) orta (47) est gravis seditio (47) parsque (1) militum (6) a ceteris (57) desciverat et ducem (39) sibi (35) fecerat (31). 6. Interim Roma legatos (41) venisse (19) nuntiatum (67) est; quibus (27) obviam (67) nuntii ab Hannibale missi sunt, qui (27) dicerent (62) Hannibali in tanto (40) discrimine rerum (13) non operae pretium (Eng. 'worth while') esse legationes audire (4). Non admissi protinus (41) Carthaginem venerunt (19); sed ea (37) quoque (20) irrita legatio fuit (38). 7. Pavor inde (43) perculit Romanos (20), auxitque (60) pavorem consulis vulnus (40) periculumque (55), qui quidem (56) pubescentis filii (7) auxilio (37) servatus (10) esse dicitur (62). 8. Hic (37) erat juvenis (41) penes (67) quem perfecti (39) hujusce (37) belli (16) laus (22) est, Africanus ob (67) egregiam victoriam (37) de (67) Hannibale Poenisque (69) appellatus (43). 9. Fuga (35) jaculatorum maxime (51) effusa (39) erat; equitatus (39) consulem (63) in castra (37) nusquam (28) trepide cedendo reduxit (43). 10. Postquam (43) rex (8) finem (40) loquendi (52) fecit (31), legati (41) Jugurthae, paucis (72) respondent (18): 'Hiempsalem ob (67) saevitiam suam (20) ab Numidis interfectum: Adherbalem ultro bellum (16) inferentem (53) postquam (43) superatus (55) sit queri (54), quod (67) injuriam (54) facere (31) nequivisset (56): Jugurtham ab senatu (19) petere (65), ne alium (31) putarent (49) ac Numantiae cognitus (65) esset, neu (70) verba (60) inimici (52) ante (43) facta (43) sua ponerent (29).'

B.

1. There was (38) a time (17) in which (27) the earth (8) is first (47) sprinkled (14) with glassy hoar-frost, and the birds (49) covered with a leaf (56) complain (54). 2. I fear (60) that, whilst (21) I wish (53) to diminish (60) (your) labour (71) I may increase (60) (it). 3. Parmenio (Lat. same) wished (53) to deter (58) the king (8) from (58) drinking (14) the medicine (58) which the physician (29) had determined to give (62) (him). 4. After-that (43) the blood (35) flowed (pass.) (31) (from his) cut (37) neck, they broke (37) into (67) complaints and lamentations. 5. He immediately (33) soothed the anger (use plural) (40) of all (29) and repressed the sedition (47). 6. Hanno alone (Lat. 'solus') entreated the Senate (19) that they should not (18) undertake (47) the Roman war (16); he says (56) that he advised (30) them that they should not (18) send (43) the son (7) of Hamilcar to the army (19); (he says) that the shades (66) of that (37) man (18) would not rest, and ('with not,' Lat. 'nec') that the Roman treaties (65) would never (Lat. 'not ever') (69) rest (undisputed) until (18) some one (70) of the blood (35) of Barcinus survived (50). 7. Sempronius, greedy (46) for the contest, led out to the insurrection (Lat. 'tumultus') at first (47) all (29) the cavalry (39) of the Numidians, next (19) six thousand (44) of the infantry (35), lastly all (29) the forces (46). 8. It was (38), by chance (60), the time (17) of the winter-solstice (Lat, 'bruma') and a snowy day (8): it happened (74) (imper. tense) that (Lat. 'quod') the men (5) and (33) horses (13) having been hastily led out, food (12) not having been taken (26) beforehand (Lat. 'ante'), there was- no heat (18) (Lat. 'nothing (31) of heat') -in (50) (them), and on-this-account (Lat. 'eo') the force (54) of the cold (56) breathed on (them) the more sharply (54). 9. But

when they, following the flying Numidians, entered (45) the water (7), then (20) the bodies (15) of (say 'to') all (29), having come out (of the water), were stiff. So that there was scarcely (39) the power (to them) of holding (18) (their) arms (36), and they were weak with hunger (40).

LESSON LXXVIII.

EXTRACT FROM VIRGIL, AENEID V., 485-518.

620. VOCABULARY 78.

English.	*Latin.*		*Derivatives.*
Swift	cĕlĕr -ris -re	R. celer, I decl.	
To contend	certāre	R. cert	
Arrow	sāgitta	G. sagittae	
Band (of men)	mānus	G. manūs, f.g. (see Voc. 61)	
Mast	mālus	G. mali	
To erect	ērigĕre	P. R. erex	3rd R. erect
Swift	vōlūcer -cris -cre	R. volucr, I decl.	
Rope / String	fūnis	G. funis, m.g. (see 497)	
Dove	cŏlumba	G. columbae	
To aim	tendĕre	P. R. tetend, and tent	3rd R. tens
	(See Voc. 76 and 63.)		
Brazen	aereus -a -um	R. aere	
Lot	sors	G. sortis	
Favouring	sĕcundus -da -dum	R. secund (see Voc. 47)	
Green	viridis -de	R. virid, I decl.	
To bind	evincĕre	P. R. evinx	3rd R. evinct
Olive	ŏliva	G. olivae	
To break	confundĕre	P. R. confūd	3rd R. confūs
Greek	Archīvus -va -vum	G. Archiv	
To try	tentare	R. tent	tentative
Strong	vălĭdus -da -dum	R. valid	valid
To bend	incurvāre	R. incurv	curvature
	flectĕre	P. R. flex	3rd R. flex
Bow	arcus	G. arcūs, D. and Ab. pl. arcubus	
To bring forth	dēprōmĕre	P. R. depromps	3rd R. deprompt
Quiver	phărĕtra	G. pharetrae	
String (bow)	nervus	G. nervi, lit., nerve or sinew	
To twang	stridĕre	P. R. strid	No 3rd R.
To cut asunder	diverbĕrāre	R. diverber	reverberate
Opposite	adversus -sa -sum	R. advers	adverse
Rapid	răpidus -da -dum	R. rapid	
Now and for some time	jamdudum, adv.		
Vow	vōtum	G. voti, n.g.	votive
Empty	văcŭus -a -um	R. vacu	vacuity
Sky	coelum	G. coeli, n.g.	celestial
To observe	spĕcŭlāri, dep.		3rd R. speculat
To tremble	intrĕmĕre	P. R. intremu	No 3rd R.
To frighten	exterrere	P. R. exterru	3rd R. exterrit
Wing	ala	G. alae	aisle
Bird	āles	G. alitis	
To sound	sōnāre	P. R. sonu	3rd R. sonit
Shouting	plausus	G. plausūs	applause
To draw towards	adducĕre	P. R. addux	3rd R. adduct
Equally	pāriter, adv.		
To pity	miserĕri, dep.		3rd R. miserat
Knot	nōdus	G. nodi	node
Chain	vinculum	G. vinculi, n.g.	
Flaxen	lineus -a -um	R. line	linen
To bind	innectĕre	P. R. innexu	3rd R. innex
Clouds	nubila	G. nubilorum (Sing. means a cloudy sky.)	
To strike together	plaudĕre	P. R. plaus	3rd R. plaus
Black	niger -gra -grum	R. nigr	nigger
Cloud	nūbes	G. nubis	nubilous
Heavenly (upper air)	aetherius -a -um	R. aetheri	
Fall down	dēlābi		3rd R. delaps

621. EXERCISE 78.

A.

(*The two numbers refer to Verbs compounded with other Prepositions.*)

Protenus (41) Aeneas celeri certare sagitta
Invitat (14), qui forte (60) velint (53), et proemia (49) ponit (29);
Ingentique (29) manu malum de (67) nave (9) Seresti
Erigit; et volucrem trajecto (67) in fune columbam,
Quo tendant ferrum (41), malo suspendit (68) ab alto (20).
Convenēre (19 and 68) viri, dejectamque (52) aerea sortem
Accepit (28) galea (41); et primus (47) clamore (53) secundo
Hyrtacidae ante (67) omnes (29) exit (56) locus (29) Hippocoontis;
Quem modo (Eng., 'next') navali (46) Mnestheus certamine (77) victor (42)
Consequitur (66), viridi Mnestheus evinctus oliva:
Tertius (47) Eurytion, tuus, o clarissime (62), frater (14),
Pandare, qui quondam (57), jussus (29) confundere foedus (65),
In medios (35) telum (16) torsisti (70) primus Achivos.
Extremus (49) galeaque (41) ima (49) subsedit (37 and 68) Acestes,
Ausus (75) et ipse (40) manu juvenum (41) tentare laborem (71).

Tum validis flexos incurvant viribus (42) arcus
Pro (67) se (35) quisque (70) viri (18), et depromunt tela (16) pharetris.
Primaque (47) per (67) coelum nervo stridente sagitta
Hyrtacidae juvenis (41) volucres diverberat auras (55);
Et venit (19), adversique infigitur (66 and 68) arbore (1) mali.
Intremuit malus, timuitque (60) exterrita pennis (14)
Ales, et ingenti (29) sonuerunt omnia (29) plausu.
Post acer (54) Mnestheus adducto constitit (53) arcu,
Alta (20) petens (63), pariterque oculos (18) telumque tetendit (76):
Ast (50) ipsam (40) miserandus avem (49) contingere (42 and 68) ferro
Non valuit (62); nodos et vincula linea rupit (37),
Queis (27) innexa pedem (44) malo pendebat (68) ab alto (20).
Illa (37) Notos (72) atque (33) atra (39) volans (45 and 68) in nubila fugit (27).
Tum (20) rapidus jamdudum arcu contenta (76 and 68) parato (52)
Tela (16) tenens (18), fratrem (14) Eurytion in vota vocavit (11):
Jam (33) vacuo laetam (33) coelo speculatus; et alis
Plaudentem nigra figit (66 and 68) sub (67) nube columbam.
Decidit (64 and 68) exanimis (66), vitamque (11) reliquit (26) in astris (61)
Aetheriis, fixamque (66 and 68) refert (53 and 68) delapsa saggitam.

B.

Questions on the above.

1. Decline 'Aeneas' (485). 2. Parse 'velint' (486). 3. What is the prose form of 'convenēre' (490). 4. Explain 'sortem' (490). 5. Parse 'omnes' (492). 6. Decline 'locus' in plural. 7. Decline 'Mnestheus' (493). 8. Parse 'torsisti' (497). 9. 'Galeaque ima' (498). What other adjectives are used in this way? 10. Decline 'arcus' (500). 11. What would 'post' (507) be in prose. 12. Line 508, paraphrase. 13. Decline 'alis' (515). 14. Give principal parts of 'decidit' (517). 15. Decline in sing. 'examinis' (517). 16. Go through tenses of 'refert.' Scan lines 492, 498, 505, and 512.

(*To be continued.*)

—o—

Popular Mythology.

BY THE REV. SIR GEORGE W. COX, BART., M.A.,
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[These papers are designed for our youngest readers. Used as themes for composition work, they will be found invaluable.]

CHAPTER V.

APNA PURNA [ANNA PERENNA].

APPLES, GOLDEN.—The traditions of the Aryan nations are full of stories which make mention of golden apples. Of these apples, some represent the sun, and others not less clearly are the golden-tinted clouds seen in the east and in the west on the coming up and the going down of the sun. But in the Greek the word Mēlon, in the plural Mēla, denoted both apples and sheep; and thus were multiplied the tales which spoke of the clouds as flocks. These tales are perhaps among the very oldest of all myths. In the earliest hymns of the Rig Veda, the sacred books of

the Hindus, the clouds, as moving across the heaven and as nourishing the earth with their showers, are addressed constantly as the herds of cows, which form the wealth of the sun-god, Indra. The word *cow* means probably nothing more than the thing which moves, and the Greek Probáton for a sheep also means nothing more; and so the word might be applied equally to the clouds which give rain from above, and to the animals which give milk on the earth. The likeness being once seen, a vast number of ideas and images grew up from the comparison. In the Odyssey these cows are the cattle of Helios (the sun), whom the nymphs Phaëthousa and Lámpetiê (the *bright* and the *glistening*), the children of Neaira (the *early* dawn), feed in the pastures of Thrinakia. But these cows are seen daily throughout the year, and so in this legend the cattle are divided into seven herds of fifty each; and the killing of the cows becomes an expression equivalent in meaning to the wasting of the days, or a misuse of time. In almost all cases, however, the cows are the clouds, and they may be said to be stolen in various ways. They may lose their light and disappear when the sun has gone down; they may be driven away by the wind, or they may be supposed to be imprisoned by the malignant beings who afflict the earth with drought, famine, and sickness. All these notions have given rise, each, to a vast number of stories. In the Greek mythology, the great cattle-stealer is Hermes, the wind-god, who, when only a few hours old, drives the herds of Appollon from their feeding grounds, and then passing through the keyhole of his mother's cave, lies down as a babe, singing gently and playing with the clothes of his cradle. In India, the same robbery is committed by the Panis, by Ahi, Vritra, and the Maruts [Aloadai]. These are supposed to steal them, chiefly for the sake of their milk—in other words, from a wish to deprive the earth of the nourishing rain. This is exactly the part played by the Theban Sphinx, and the Pythian dragon, as well as by the dragon slain by Kadmos. In each of these cases the death of the monster is followed by the outpouring of the waters.

The pastures of the Sun, where his herds feed, thus answer to the beautiful gardens, where the Hesperides, or nymphs of the evening, keep watch over his golden apples. These apples Gaia (the *earth*), gave to Hêrê when she became the bride of Zeus; but among them is one pre-eminent in brightness, and this is the orb of the Sun himself, which becomes the golden ball seen in a vast number of German and Norse tales. The sun setting, or, as it was said, sitting on the horizon or the ocean's edge, was called in old Hindu hymns Bheki, the frog; and this is the Frog Prince of the German story in Grimm's collection of Household Tales, with which all who care to know anything about Mythology ought to make themselves thoroughly familiar. No more delightful task could be devised for any one. In this story of the Frog Prince, the princess, who represents the lovely light of morning or evening, is playing with a golden ball, which slips from her hands into the water, and it can be brought back to her only by the Frog, that is, by the sun, when he reappears on the eastern horizon. But the Frog makes it a condition that before he restores the ball, she must become his wife; and all who read the tale will see how closely it describes the events which might be supposed to occur between the setting and the rising of the sun. In the story called the 'Man of Iron,' the golden ball with which the king's son is playing, rolls not into the water, but into the cage in which the wild man (the *winter*) is shut up. In the story of the 'Old Griffin,' the ball is changed into golden apples, which restore the king's daughter to health, and it becomes the red-hot egg which the bird drops, in the story of the 'Ball of Crystal,' and, of course, also the golden egg laid by the goose every morning. These tales are closely connected with a multitude of other stories. Thus it is the Frog who, in the story of Briar Rose, promises the Queen that she shall have a daughter, and who in the 'Three Feathers,' gives Dummling (Tom Thumb) the beautiful carpet (of clouds, the web of Penelope). In this story the clouds appear not only as an embroidered carpet, but as sheep. The vapours in the mackerel sky are reflected in the water; and Dummling cheats the farmers, who have lost their sheep, by telling them to look down into the river, where they shall see them, and get them, too, if they choose to jump in after them. The farmers follow his advice and are drowned. In the story of the 'Faithful Beasts,' the Frog brings up from the water the wonderful stone (the sun's orb), the owner of which can wish himself in whatever place he desires to be. In the 'Nix of the Mill Pond,' the man and his wife are changed into a toad and a frog, thus pointing to the disappearance both of the sun and the twilight after nightfall, or to the conquest of the summer by the dark powers of winter.

But the Sun not only loves, but is loved by, the bright beings who represent the dawn: and thus we understand how at the marriage of Peleus and Thetis [Achilleus] Eris, *Strife*, casts the golden ball upon the table, as a gift for the fairest. [Judgment of Paris.]

The confusion of meaning between apples and sheep is seen again in the name Philomela, which may mean one who loves flocks or one who loves apples, but who in either case is a lover of the golden-tinted clouds. The fleecy clouds, Dummling's sheep, reappear in the Bœotian story of Linos, who is torn to pieces by dogs (the demons of winter), and for whom the matrons and maidens mourned at the feast which was called Arnis, because he had grown up among the lambs.

Apples and Sheep. [Apples, Golden.]

Apsaras in old Hindu mythology are the maidens of the waters, called by the Greeks, Nymphai, nymphs, whose name reappears in the Latin *lympha*, water. These nymphs were supposed to have a magic power over human beings; and one under this power was called Nympholeptos, in Latin, Lymphaticus [Selene]. In their beauty and in the conditions of their life the Apsaras answer also to the Greek Naiads, from the root *na*, to swim, which we find again in the Teutonic Nix or Nixie (Gr. necho, to swim), and in 'Old Nick' as a name for the sea-god who, when placed under the ban of Christian teachers, became a demon or devil, like 'Old Harry' [Ahriman].

Arcturus is the Latin form of the Greek Arktouros, the guardian of the bears. The seven stars of the constellation now known as the Great Bear were called at first the seven *Arkshas*, or shiners, from a root *ark*, *arj*, to shine. But the same root appears in Arktos, the Greek, and Ursa, the Latin name for the bear: and so the seven shiners were transformed into seven bears, and Arktouros was assigned to them as their

bearward. In India the same root supplied a name denoting the wise man, and then the seven shiners became the seven Rishis or sages, who reappear in the seven champions of Christendom, the seven sleepers of Ephesus, the seven wise men of Hellas, and the seven wonders of the world.

ARION is mentioned by Herodotus as a celebrated musician living in the days of the Corinthian tyrant, Periandros; and of him the historian says that he went to the southern part of Italy, then known as Megalê Hellas or Magna Græcia (Great Greece), from the number of Greek colonies established in it, and having amassed great wealth, hired a ship to take him back to Corinth. On the voyage the sailors resolved to murder him and seize his money. On being bidden to prepare for death, Arion asks to be allowed to put on his most splendid garb and to play one tune upon his harp, promising that when he had done so he would leap overboard. This request, we are told, it was impossible for them to refuse. His harping charmed the sailors, and it also brought to the side of the ship a dolphin, which, when he leaped into the sea, bore him on its back to Corinth, which the sailors reached only to find that their victim had escaped, and to suffer the due punishment for their crime.

It is clear that in these sailors we have the rogue in Grimm's story of the 'Jew among the Thorns,' in which the harp or fiddle of the faithful servant has the same magic power with that of Arion. This mysterious harp is the lyre of Hermes, whose music has a witchery which none can resist, and it reappears in that of Sigurd, of Bosi, of Oberon, Glenkundie, and the Fiunic Wäinämömen, with many more. It is the music of the wind, the breeze, the gale, the storm; and the divine musicians are Hermes, Orpheus, Amphion, Pan, and Syrinx.

ARETHOUSA, ARETHUSA, is called one of the Nereïdes, Nereids, or nymphs [APSARAS], the daughters of Nereus, the water-god, whose name, under the form Nêro, the Greeks still retain as the name for the sea. The story told of Arethousa is that she was loved by the huntsman Alpheios, from whose pursuit she fled, and plunging into the sea, on the western coast of the Peloponnesos, was carried to the Ortygian shore, where, united with Alpheios, she became the nymph of the Ortygian fountain. This spot was identified with the islet of Ortygia, lying off the Sicilian coast, opposite to Syracuse; but it belongs to no earthly geography. Ortygia was a name not only for this Sicilian rock, but also for Delos; and it means literally the land of the quail. But the quail is the bird which first announces the return of the spring, and so of light, life, and fertility; and Alpheios is the sun, as the hunter, rising from the waters, and plunging into the waters again in his chase after the beautiful maiden, whom he has failed to win in the morning. The story is, in short, the counterpart of the story of Apollon and Daphne; and Alpheios is strictly the elf, who rises from the Elbe, the running stream. Such tales simply mean that the sun loves the dawn, but that the more eagerly he pursues her, the more swiftly she flies, and vanishes before his fiery chariot rises high into the heaven. A like story is told of Hippodameia, Atalantê, Camilla, and Bolina, all of whom can be won only by those who can outstrip them in the race.

ARES, in Greek mythology, is strictly the crusher or pounder [ALOADAI]. He is called a brother of Hebe and Hephaistos, and a lover of Aphrodite. In later times he was spoken of as a god of war, and was said to be the same as the Latin MARS; but the Roman Fetiales, or heralds, refused to admit this identification, and they were right. Ares is strictly the storm-vapour, from which the lightning and thunder may at any time burst forth. He is thus sometimes in conflict with the Aloadai, who succeed in imprisoning them. Like them he is of enormous size, and he is able to magnify his bulk, while his roar, which is the crash of the thunder, is louder than that of an army of lions. He is, therefore, in no sense a god of war, unless war is to be taken as mere quarrelling and slaughtering for its own sake. For the merits of the contending parties he cares nothing; his only desire is to be where the carcases lie thickest. Hence he is steadily opposed by Athene, the armed goddess of the dawn, whose mind is as clear as her arm is strong. He is also the object of hatred and disgust to all the gods; and as in spite of its fury the storm-wind must soon be conquered, so the life of Ares is little more than a series of disasters. In trying to defend his son Kyknos, he is defeated by Herakles, and he is wounded by Diomedes, who fights under the protection of Athene.

ARGEIPHONTES, 'slayer of Argos,' or '*Argosbane*,' is a name given to Hermes as the slayer of Argos Panoptes, or Argos with the thousand eyes, whom Hêrê sends to guard Iô, the horned maiden. In some versions of the myth these eyes are placed on his brow and on the back of his head; in others they are scattered all over his body. The story is transparent. Argos is the star-illumined sky watching over the crescent or horned moon, which, in Shelley's words, 'wanders companionless among the stars that have a different birth.' But the stars vanish when the morning breeze ushers back the sun, and so the sword of Hermes falls on the neck of Argos, and the moon is left alone. In other tales the moon, as Asterodia, is said to have her path among the stars, and as such, she was by the Germans called Ursel or Ursula, popularly known as St. Ursula, with her eleven thousand virgins, the host of stars which glitter in the nightly heaven.

As Hermes is the bane or slayer of Argos, so Hipponoos is Bellerophon, the slayer of the monster Belleros, as Sigurd is Fafnirsbana, or the bane of the dragon Fafnir, and Beowulf is the bane of the demon Grendel. Indeed, all the heroes are the bane of some hateful and malignant beings, whose death brings wealth and happiness to men.

(To be continued.)

How I Teach Domestic Economy.

BY MRS. WIGLEY,

Author of 'Marshfield Maidens,' 'Our Home Work,' 'Workers at Home,' 'Royal Series Domestic Economy,' 'Cookery and Home Comforts,' 'The Merryweathers,' 'Thoughts,' etc.

CHAPTER XIV.

THE RIGHT BALANCE OF OUR DIETARY.

DIFFERENT kinds of Food. Food to make force and generate heat. Food to nourish and build up. Food that supplies the necessary mineral matter. By the consideration of this much of our subject we have

answered one interrogation—'*What food?*' We now have to consider another—'*How much food?*' And if we are to show our conviction of the truth we have before hinted at, 'That one ounce of intelligent teaching is worth a ton of mechanical cram,' we must go to the root of the matter, and endeavour to give our children at least some small idea of the necessary balance in diet.

And we shall prepare the way by familiar illustration. Most of our children keep pets of some kind. They will be able to tell us at once what is the result of filling the canary's seed-glass every day. They have seen for themselves that the little bird wastes because it has more than it needs. It is the same with all animals.

We can tell them that cattle in the fields, beasts in the stall, horses in the stable, if supplied with an abundance of any food—growing grass, oil-cake, oats, beans, or hay—will waste more under their feet than they take into their bodies for nourishment.

No living thing must appropriate more food than is necessary, if it is to live a healthy life. Our wonderful little organs and glands can do *sufficient* work for us, but they were never created to do as much work as we choose to lay upon them. If we are overworked we suffer, and if they are overworked there is the same result, and we who depend upon them for our support must suffer also.

There is no manner of doubt that a good deal of good food is wasted after it has been put into the mouth. The pleasures of the palate, though to be ranked among the least of all pleasures, are a great temptation to many. We have our especial liking for this or that, and we are in danger of forgetting that only so much of the constituents of the delicacy can be made use of in the body. If, then, because we derive a certain kind of gratification from the prolonged enjoyment of its flavour, we load our internal organs with that they have no use for, they have to spend their strength in *getting rid of it.*

We cannot impress this fact too strongly on the children's minds. If we put too much of any kind of food into our bodies we shall do mischief and cause waste; *too much* is an incumbrance, and just rubbish matter. It is cast from the body by one organ or another, and those organs get more work than they are fit for in getting rid of it. They make use of as much as they can, and they throw the rest away in some form or other.

Cattle are immoderately fond of green corn. Sometimes when the farmer's hedges are faulty, the animals break through into his fields among his wheat, and enjoy their pet liking until they are found out. They gorge and gorge, and appear unable to get enough. Well, when they are driven out, evil consequences are sure to follow their feasting. They have stuffed themselves with more than their internal organs have strength to get rid of. They lie down, and roll and groan in pain. The cattle-doctor is sent for; strong medicines are administered. Sometimes these take effect, but only too often the poor silly animals, who could not tell when they had taken enough, die within a few hours.

Too much food of any kind means internal organs overtaxed; internal organs overtaxed means disease; disease means, for a time, a miserable existence, without bright energy, or great usefulness, or high hopes carried out, and a premature death at last.

Many an eminent physician has stated over and over again that considerably more than half the disease in the world comes from overfeeding. If every well-to-do family kept a doctor in the kitchen, they would seldom need to seek the aid of one anywhere else.

The first study of such a household treasure would be to keep healthy our internal organs. Now, there are two things which must be considered with regard to health:—

(*a*) These organs must be supplied with the right food needed for their own support.

(*b*) They must not be used for anything except their own work. *They have to appropriate and reduce food, not get rid of over-supply.*

Now, a poor person and a rich person may suffer alike from weakened digestive organs, or what is called commonly indigestion. The rich eat too much good food; the organs are weakened by overwork in trying to get rid of this *too much.* The poor cannot get *enough* of the food they require, or rather they *do not know how* they are to provide themselves with what they need; so their organs get weakened from the want of a proper supply. In both cases suffering and disease, and loss of strength and vigour, is the result. Not the same disease, perhaps—we seldom hear of a poor person having gout—but disease from the same cause, weakened internal organs through improper diet, or, in other words, weakened internal organs resulting from the lack of a right balance in the dietary.

What, then, is to determine a matter so important? Who is to regulate the quantity for us?

Both these questions are easily answered. In the first place, *the demand* must settle the supply; in the second, our own common-sense must be our regulator.

A certain vessel *must* be kept full of water; but from various causes the water wastes or is used. What should we say to the person in charge if they hurried hither and thither in a panic, making frenzied inquiries as to how much water they must put into the vessel to keep it up to the mark? Would not any one of us answer impatiently, 'Why, put as much as has been used out'?

That's the whole secret. *The kitchen doctor puts into the body day by day just as much of the various kinds of food as will supply afresh the various substances which have been used out of it during the day.*

In the case of children more than this will be required, as they have not only to repair what has been used, but to build up the growing organism.

We all know that the waste of the body depends upon the work of the body. We cannot lift the hand, move an eyelid, or think a thought without some part of the body wasting away. Now, the whole human race may be classed under three heads—

1. Those who do much.
2. Those who do little.
3. Those who do nothing.

We shall not need to remind ourselves that *much work* means *much waste*, or that little work means little waste. Our greatest workers, be they mental or physical workers, will need the largest supplies of food, just as our moderate workers will not require so much.

We need not trouble ourselves very much about those who do not work at all (unless they be our dear sick ones); they will be sure to get enough.

Now, as to the actual waste of the body, and the consequent necessary repair of such waste.

There have been delivered at various periods during the last few years certain lectures to the people which have brought out these subjects—the 'Health Lectures,' published in Edinburgh by Macniven and Wallace, and the lectures delivered at the Royal Institution, London. And I wish here to introduce certain tables showing the waste and decay of the body, and the necessary daily supply of the various foods which must make good such waste. I made no apology in quoting from these lectures. The object of the lectures was *to teach*, and I am sure no more apt pupils could be found anywhere than are we readers of the PRACTICAL TEACHER. I may say in passing that I do not know of any more useful books on the subject than these lectures.*

We shall find that there is some little difference in some of the quantities given. We know that the amount of food consumed will depend upon more than one thing. It will be affected by—

1. Individual peculiarities.
2. Amount of work done.
3. Kind of food supplied.
4. The heat or the cold around us.

1. The appetites of some people are larger than others, naturally.

2. Some people wear themselves more while at work than others do, though doing precisely the same work.

3. Some foods are much sooner *used up* than others; we say of various kinds, 'There is no stay in it.' Of such kinds we require a larger quantity.

4. We shall require more or less of warmth-giving food, according as the weather or temperature acts upon us.

So, taking all these things into consideration, we are able to make allowance for some little difference in the result of experiment and observation on different individuals, by different individuals. Let us remember this as we proceed to profit by the researches of their superior wisdom.

(To be continued.)

—o—

Chemistry of the Non-Metallics.

[This series of articles, whilst dealing with the subjects required by the University of London for the Matriculation Examination and with those required at the Elementary Stage of the Inorganic Chemistry (Branch X.) Science and Art Department, is intended as a practical guide to the philosophical and systematic study of the non-metallics.]

CHAPTER XX.

SULPHUR—(*continued*). GUNPOWDER. SULPHUR DIOXIDE. HYDROGEN SULPHITE. SULPHUR TRIOXIDE. HYDROGEN SULPHATE.

E. Gunpowder is a mixture of sulphur with charcoal and nitre, in the proportions of 1 atom, 2 atoms, 3 molecules. These relative quantities, calculated to 100 parts, give very nearly the proportions used in the making of gunpowder, which are—

Sulphur	10.
Charcoal	15.
Nitre	75.

* 'Health Lectures for the People.' Two vols., 1s. each. Macniven and Wallace, Edinburgh.

The theoretical explanation of the results of the firing of gunpowder is that potassium sulphide, carbon dioxide, and nitre are formed.

$$S + 2KNO^3 + 3C = K^2S + 3CO^2 + N^2$$
$$32 + 202 \quad + 36 = 110 + 132 \quad + 28$$
$$\text{6 vols.} \quad \text{2 vols.}$$

The carbon dioxide and nitrogen thus formed occupy at the high temperature produced a volume many hundred times as great as that occupied by the gunpowder itself. Hence the explosive force due to ignited gunpowder. In practice, however, many more products than the three just enumerated are found to be formed, of which potassium sulphate (K_2SO_4), due to the oxidation of the sulphide K_2S, is the chief constituent of the residue of the smoke.

F. SULPHUR DIOXIDE, SULPHUROUS ACID or ANHYDRIDE, SULPHUROUS OXIDE.

(*a*) SO^2.

(*b*) 64.

(*c*) FIRST PREPARATION.—By burning sulphur.

SECOND PREPARATION.—From copper and sulphuric acid.

(1) Place copper turnings in a flask with strong oil of vitriol, and heat. Copper sulphate is left in the flask. Steam and sulphur dioxide are evolved. If these are passed through a wash bottle, the steam is condensed and the sulphur dioxide caught by displacement of air or over mercury (not over water).

(2) $Cu + 2H^2SO^4 = CuSO^4 + 2H^2O + SO^2$

(3) $63 + 196 \quad = 159 \quad + 36 \quad + 64$
2 vols.

THIRD PREPARATION.—From charcoal and sulphuric acid.

(1) By means of the same apparatus as in the last experiment, these two substances are made to give rise to carbon dioxide, steam, and sulphuric acid.

(2) $C + 2H^2SO^4 = CO^2 + 2H^2O + SO^2$

(3) $12 + 196 \quad = 44 \quad + 36 \quad + 64$
$\text{2 vols.} \quad \text{4 vols.} \quad \text{2 vols.}$

(*d*) (1) Gas: easily liquefied. A pressure of 3 atmospheres or a temperature of −18° will turn it into a liquid. If the escaping gas in the above experiments is passed into a tube surrounded by ice and salt, liquid sulphur dioxide is obtained. The boiling point of the liquid is −10°.

(2) Very irritating odour (the common 'smell of sulphur'), colourless.

(3) 32, or $\frac{32}{14{\cdot}47}$. The liquid has a specific gravity of 1·45.

(4) Very soluble in water. 100 cc. dissolve 6000 cc. of sulphur dioxide. This solution is really a true compound, hydrogen sulphite, or sulphurous acid.

$$SO^2 + H^2O = H^2SO^3$$
$$64 \quad + 18 \quad = 82.$$

By replacement of the hydrogen in this compound by other metals, metallic sulphites are formed.

H^2SO^3	...	...	...	Hydrogen sulphite.
Na^2SO^3	...	...	...	Sodium ,,
$BaSO^3$	...	...	...	Barium ,,

Tests for Sulphites.

(*a*) $+ BaCl^2 =$ white precipitate.

Na^2SO^3 (*e.g.*) $+ BaCl^2 = BaSO^3 + 2NaCl$
$126 \quad + 208 \quad = 217 \quad + 117.$

This precipitate is soluble in hydrochloric acid, unlike the precipitate produced by barium chloride with a sulphate. But if chlorine water is added after the resolution of the barium sulphite in hydrochloric acid, the chlorine water oxidises the barium sulphite ($BaSO_3$) to barium sulphate ($BaSO^4$), and this not being soluble in hydrochloric acid is precipitated.

(*β*) $+ AgNO^3 =$ no precipitate.

Na^2SO^3 (*e.g.*) $+ 2AgNO^3 = Ag^2SO^3 + 2NaNO^3$
$126 \quad + 340 \quad = 296 \quad + 170.$

(γ) $+H^2SO^4$=hydrogen sulphite liberated. The presence of a little zinc in the solution with the sulphuric acid there determines the liberation of nascent hydrogen. This reduces the hydrogen sulphite to hydrogen sulphide, and this latter gas passing off can be tested by a piece of paper soaked in a solution of lead acetate. The paper turns black because lead sulphide, a black insoluble salt, is formed.

$$Na^2SO^3 (e.g.) + H^2SO^4 = Na^2SO^4 + H^2SO^3$$
$$126 \quad +98 \quad = 142 \quad +82$$
$$Zn + H^2SO^4 = ZnSO^4 + H^2$$
$$65 + 98 \quad = 161 \quad +2$$
2 vols.
$$H^2SO^3 + 3H^2 = H^2S + 3H^2O$$
$$82 \quad +6 \quad = 34 \quad +54$$
6 vols. 2 vols.
$$Pb2\,(C^2H^3O^2) + H^2S = PbS + 2HC^2H^3O^2$$
$$325 \quad +34 \quad = 239 \quad +120$$
2 vols.

(5) Not combustible; not a supporter of combustion.

(6) Acid to moistened litmus paper, which, after reddening it, bleaches. As sulphur dioxide has a great affinity for oxygen, it is a good reducing agent. This property explains its action as a bleaching agent and disinfectant. In the presence of chlorine, sulphur dioxide decomposes water. It is therefore used to get rid of the traces of chlorine from fabrics that have been bleached by the latter gas. Hence its name, anti-chlor.

$$SO^2 + 2H^2O + Cl^2 = H_2SO^4 + 2HCl$$
$$64 + \quad 36 + 71 \quad = 98 \quad +73$$
2 vols. 2 vols.

SULPHUR TRIOXIDE, SULPHURIC ACID OR ANHYDRIDE, SULPHURIC OXIDE.

(*a*) SO^3.

(*b*) 80.

(*c*) FIRST PREPARATION.—From sulphur dioxide.

(1) Sulphur dioxide, oxidised by aid of finely divided platinum, yields sulphur trioxide.

(2) $2SO^2 + O^2 = 2SO^3$
$128 + 32 = 160$
4 vols. 3 vols. 4 vols.

SECOND PREPARATION.—From Nordhausen sulphuric acid.

(1) Nordhausen sulphuric acid is an acid specially prepared at Nordhausen in Saxony. It is really hydrogen sulphate with a molecule of sulphur trioxide (H^2SO_4,SO^3). Heated, the sulphur trioxide is given off as a gas, and can be condensed in the solid form.

$$H^2SO^4,SO^3 = H^2SO^4 + SO^3$$
$$178 \quad = 98 \quad +80$$
2 vols.

D. (1) Solid; occurs in long silky fibrous crystals, melting at 16°, boiling at 46°.

(2) Odourless: white.

(3) 1·94.

(4) Very soluble, combining with water with great evolution of heat, to form hydrogen sulphate or sulphuric acid.

$$SO^3 + H^2O = H^2SO^4$$
$$80 + 18 \quad = \quad 98.$$

SULPHURIC ACID is, however, rarely prepared in this way. For manufacturing purposes two methods are employed.

(α) FIRST PREPARATION OF SULPHURIC ACID.—From iron sulphate (green vitriol).

This salt, heated, yields the strongest form of the acid, the Nordhausen. The name, oil of vitriol, comes from the fact that the acid is prepared from 'green vitriol.'

SECOND PREPARATION.—English method.

Sulphur, or iron pyrites (FeS^2), is burnt in a furnace. The vapour of sulphur dioxide thus formed passes through flues in which are pots containing nitre and sulphuric acid. The fumes from the pots, consisting largely of nitrogen trioxide and the sulphur dioxide, pass into a leaden room whose floor is covered with water. The nitrogen trioxide, sulphur dioxide, and water form hydrogen sulphate and nitrogen dioxide. This last becomes oxidised by the oxygen of the air in the leaden room to the condition of nitrogen trioxide again, and the same reaction recurs. When the acid has reached a certain strength (specific gravity 1·6) it is drawn off and concentrated in pans of lead, then in stills of platinum, until it has a specific gravity of 1·84.

The manufacture of sulphuric acid can be illustrated in the laboratory by means of the apparatus represented in

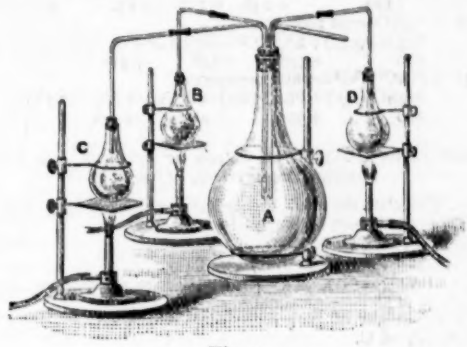

Fig 47.

Fig. 47. In flask B are copper and nitric acid. Hence nitrogen dioxide is liberated. This unites with the air to form nitrogen trioxide. In flask C are copper and sulphuric acid. Hence sulphur dioxide is liberated. In flask D is water, whence by application of heat steam is liberated. The gas from B is allowed to enter the central flask (which represents the leaden room) first. Then this first gas is shut off, and the sulphur dioxide from C is admitted, and finally steam is driven in. The red fumes of nitrogen trioxide disappear and sulphuric acid is formed. By blowing air into the central flask A, the red fumes are re-formed, and these processes can be repeated several times.

(1) $S + O^2 = SO^2$
$32 + 32 = 64$
2 vols. 2 vols. or
$$4FeS^2 + 11\,O^2 = 2Fe^2O^3 + 8SO^2$$
$$480 + 352 \quad = 320 \quad +512$$
22 vols. 16 vols.

(2) $2KNO^3 + H^2SO^4 = K^2SO^4 + 2HNO^3$
$202 \quad + \quad 90 \quad = \quad 174 \quad + \quad 126.$

(3) $SO^2 + 2HNO^3 = H^2SO^4 + 2NO^2$
$64 \quad + \quad 126 \quad = \quad 98 \quad +92$
2 vols. 2 vols.

(4) $3NO^2 + H^2O = 2HNO^3 + NO$
$138 \quad +18 \quad = 126 \quad +30$
6 vols. 2 vols. 2 vols.

(5) $4NO + O_2 = 2N^2O^3$
$120 \quad +32 \quad = 152$
8 vols. 2 vols. 4 vols.

(6) $N^2O^3 + SO^2 + H^2O = H^2SO^4 + 2NO$
$76 \quad +64 \quad +18 \quad = 98 \quad +60$
2 vols. 2 vols. 4 vols.

(β) (1) Liquid, freezing at 10½°, boiling at 338°.

(2) With heavy acid odour, intense acid taste, colourless, oily.

(3) 1·84, Nordhausen acid has specific gravity 1·9.

(4) Combines with water, with great evolution of heat, and with condensation. The amount of condensation is about 8 per cent., and this definite hydrate has formula $H^2SO^4, 2H_2O$.

(5) Not combustible.

(6) A very powerful acid, dissolving most of the metals. Some, as zinc, it dissolves at once; others, as copper, only when heat is also applied. A few, as gold, resist its action at any temperature.

If the hydrogen in hydrogen sulphate is replaced by other metals, sulphates are formed.

H^2SO^4	...	...	Hydrogen	sulphate
K^2SO^4	...	...	Potassium	,,
$KHSO^4$	...	...	,, hydrogen	,,
$CaSO^4$	...	...	Calcium	,,
$Cr^2(SO^4)$	...	...	Chromium	,,

Tests for Sulphates.

(1) $+BaCl^2$ = white precipitate. Not soluble in any known liquid.

$$\begin{array}{llll} MgSO^4(e.g.) & +BaCl^2 & = BaSO^4 & +MgCl^2 \\ 120 & +208 & =233 & +95. \end{array}$$

(2) $+AgNO^3$ = no precipitate.

$$\begin{array}{llll} MgSO^4(e.g.) & +2AgNO^3 & = Mg2NO^3 & +Ag^2SO^4 \\ 120 & +340 & =148 & +312. \end{array}$$

(3) $+Pb2C^2H^3O^2$ = white precipitate.

$$\begin{array}{llll} MgSO^4(e.g.) & +Pb2C^2H^3O^2 & = PbSO^4 & +Mg^2(C^2H^3O^4) \\ 120 & +325 & =303 & +142. \end{array}$$

EXAMPLES ON GUNPOWDER, OXIDE OF SULPHUR AND ACID FORMED FROM THEM. (*Solved.*)

111. Calculate the exact theoretical proportions by weight of the three constituents of gunpowder.

$$\left.\begin{array}{l} S+2KNO^3+3C \\ 32+202 \quad +36 \end{array}\right\} \text{ or } 32+202+36=270$$

270 by weight of gunpowder contains 32 of sulphur, 202 of KNO^3, 36 of C.

1 by weight of gunpowder contains $\frac{32}{270}$,, $\frac{202}{270}$ of KNO^3, $\frac{36}{270}$ of C.

100 by weight of gunpowder contains $\frac{32\times100}{270}$,,

$\frac{202\times100}{270}$ of KNO^3, $\frac{36\times100}{270}$ of C = 11⅞ S, 74⅞ KNO^3, 13⅓ C.

112. Find the theoretical volume of gas formed when 270 grams of gunpowder are ignited, if the temperature is 520°.

270 grams gunpowder yield (theoretically) 8 vols. of CO^2 and N.

273 vols. at 0° become 793 at 520°.

1 vol. ,, becomes $\frac{793}{273}$,,

$8\times11{\cdot}2$ litres ,, become $\frac{793\times8\times11{\cdot}2}{273}$ = 260$\frac{4}{7}$ litres.

113. Find the percentage composition of acid potassium sulphite.

$$\left.\begin{array}{l} KHSO^3 \\ 39+1+32+48 \end{array}\right\} \quad \ldots \quad \ldots \quad 39+1+32+48=120.$$

120 grams $KHSO^3$ contain 39 K, 1 H, 32 S, 48 O.

1 gram ,, contains $\frac{39}{120}$,, $\frac{1}{120}$,, $\frac{32}{120}$,, $\frac{48}{120}$,,

100 grams ,, contain $\frac{3900}{120}$,, $\frac{100}{120}$,, $\frac{3200}{120}$,, $\frac{4800}{120}$,,

32½K, ⅚H, 26⅔S, 40O.

114. What weight of lead sulphide will be formed in the process of testing for a sulphite, if the original quantity of sodium sulphite decomposed is 63 grams?

126 grams Na_2SO_3 yield $82H^2SO^3$, which yield $34H^2S$, which yield 239 PbS.

1 gram ,, corresponds with $\frac{239}{126}$ grams PbS.

63 grams ,, correspond ,, $\frac{239\times63}{126}$ = 119½ grams.

115. What volume of sulphur dioxide must be oxidised that the sulphur trioxide formed may, when combined with water, precipitate 416 grams of barium chloride?

208 grams $BaCl^2$ need 98 grams H^2SO^4, from which 22·4 litres SO^2 might be freed.

1 gram ,, corresponds with $\frac{22{\cdot}4}{208}$,,

416 grams ,, correspond ,, $\frac{22{\cdot}4\times416}{208}$,,

4 vols. SO^3 are yielded by 4 vo's. SO^2

1 vol ,, is ,, $\frac{4}{4}$,,

$\frac{22{\cdot}4\times416}{208}$ . . $\frac{4\times22{\cdot}4\times416}{4\times208}$ = 44·8 litres.

116. If 14 grams' weight of nitrogen trioxide and sulphur dioxide are delivered into the leaden chamber, what weight of water is necessary to combine with them in forming sulphuric acid?

76 + 64 = 140 grams ($N^2O^3+SO^2$) need 18 grams H^2O

1 gram ,, needs $\frac{18}{140}$,,

14 grams ,, need $\frac{18\times14}{140}$ = 1·8 grams.

117. What is the weight of the precipitate thrown down when 60 grams of magnesium sulphate (in solution) are treated with twice their weight of barium chloride (in solution)? and what weight of the sulphate or of the chloride is not decomposed?

120 grams $MgSO^4$ need for complete precipitation 208 grams $BaCl^2$ yielding 233 grams $BaSO^4$

1 gram $MgSO^4$ needs for complete precipitation $\frac{208}{120}$ grams $BaCl^2$ yielding $\frac{233}{120}$ grams $BaSO^4$.

60 grams $MgSO^4$ need for complete precipitation $\frac{208\times60}{120}$ grs. $BaCl^2$, yielding $\frac{233\times60}{120}$ grams $BaSO^4$.

$\therefore \frac{233\times60}{120}$ = 116½ grams $BaSO^4$ are precipitated, and 120 − 104 = 16 grams $BaCl^2$ are undecomposed

EXAMPLES ON GUNPOWDER, OXIDE OF SULPHUR, AND THE ACID FORMED FROM THEM. (*For Solution.*)

116. In 2 kilograms 7 hectograms of gunpowder how much is present of each of the three metals, theoretically?

3 hectograms 2 decagrams S, 2 kilograms 20 grams KNO^3, 3 hectograms 6 decagrams C.

117. In what temperature must the gases theoretically given off by 27 grams of gunpowder be raised that under a pressure = 380 mm. they may occupy a volume of 47$\frac{4}{7}$ litres?

455°.

118. The percentage composition of acid sodium sulphate.

19½ Na. ½ H, 26½ S. 52½ O.

119. Find the weight of zinc that must be dissolved to liberate enough nascent hydrogen for the decomposition of 41 grams of hydrogen sulphite . . . . . 97½ grams.

120. How much nitric acid is necessary to unite with the sulphur dioxide resulting from the burning of 8 grams of sulphur? . . . . . 31½ grams.

121. What weight of copper sulphate will be precipitated by 32·5 grams of lead acetate? . . . . . 15·9 grams.

122. The percentage composition of antimony chloride ($SbCl^3$). . . . . Sb53$\frac{11}{17}$, Cl46$\frac{6}{17}$.

(*To be continued.*)

Lectures on Shakspere's 'King Lear.'

BY H. MARMADUKE HEWITT, M.A., LL.M.

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No. II.

OUR remarks last month took us only a little way into our subject. Scarcely, as it seemed, had we warmed to the work, when the three columns accorded to us by our able and courteous editor had been filled up. As our observations at the commencement were necessarily a little discursive, we shall do all we can this time to fill up the space at our disposal with solid matter.

We shall begin by taking up our list of 'marked passages' from Act I., Sc. 1, just where it was left off in the first article.

Lear was disposed, he says, to *set his rest on* Cordelia's nursery. The metaphor is taken from the gaming-table. *Rest*, we are told, means 'stake,' or 'the highest stake for which a man felt disposed to play.' Lear, then, was inclined at one time to stake his all upon Cordelia's affection, and well he might have done so.

To *dismantle so many folds of favour* is evidently to deprive his youngest daughter of the affection which he had hitherto displayed towards her. The metaphor implies that she had hitherto been enfolded in his love, wrapped up in his affections as in a garment. This is not a common metaphor in English, though we do say that a person is '*wrapped up*' in a particular pursuit,

and that his heart '*clings to*' another. Again, according to the ordinary usage of this verb, it is a *person* who is 'dismantled,' and not the garments. *Respects that stand aloof from the entire point* are considerations which are as remote as possible from the matter at issue; but there is much difficulty in the epithet *entire*, and we certainly get very little help from being told that *entire* means 'single,' or unmixed with other considerations. May we not suggest that the word which is qualified by *entire* is, not *point*, but *aloof*; as though the author had written *entirely aloof*? The speaker is talking of love, and with real love, he thinks, considerations of material advantage have nothing whatever to do.

A similar transfer of meaning is found in many a Greek sentence.

In *our potency made good* we seem to have an exemplification of the 'absolute' case (the English equivalent of our old acquaintance, the ablative absolute). Many grammarians have named this the nominative absolute; but as the absolute case in Old English was the dative, 'absolute case' seems a more accurate expression. We may, perhaps, paraphrase it by 'to make good, or vindicate, our authority,' though the words express, not a purpose, but a concomitant circumstance. The Clarendon Press edition gives us no help in the two difficult lines by which these words are preceded. By *sentence* is probably meant Lear's determination, and by *power* the execution thereof. Kent has come between these two—*i.e.*, he has endeavoured to prevent his resolution from being carried into effect, and this, says Lear, 'is what neither my own temper nor any king's majesty (*nor our nature, nor our place*) can put up with.

Why is there no article before *child* in the expression *as much as child e'er loved*? The omission occurs when a notion has to be represented in its universality. Is this too technical? '*A* child' would have been equally good English, did the metre permit the extra syllable; but *child* is intended to mean any child whatever. Compare the lines—

(*a*) 'Creeping like *snail* unwillingly to school.'
(*b*) 'More tuneable than *lark* to *shepherd's* ear.'

Here the whole species of *snails*, *larks*, and *shepherds* is alluded to, and what is asserted of one is, as it were, asserted of all. Again, since *an* or *a* had only recently ceased to mean 'one,' the insertion of the article where we unhesitatingly place it now, would in many cases have appeared too emphatic. What about *Good my lord*? What we were accustomed to be told was that this was a transposition of '*my good lord*,' and with beautiful docility we took down this statement in our note-books, without asking or wondering why Shakspere wanted to transpose them. It was Dr. Abbott, we think, who first pointed out that wherever such a transposition occurs, the last and penultimate words are capable of being combined into an expression like 'good Monsieur,' or 'good milord,' and, of course, 'good Monsieur So-and-so' would be anything but an unnatural combination. *Thou, my sometime daughter*, means 'thou who wast once my daughter (but hast forfeited the title).' Here an adverb takes the place of an adjective like 'former.' Compare 'the *then* Bishop of London,' or 'the *up* train.' Students of Greek will not need to be reminded of the parallel expressions for 'the men of old,' etc. In *Ourself, by monthly course*, Lear assumes the mode of speaking in vogue with monarchs and editors which is sometimes designated 'the editorial We.' Each of these august personages is privileged to think that he is 'a host in himself.' In *Be Kent unmannerly*, the subjunctive mood seems to do duty for the imperative, unless we assume that *let* is understood, in which case *be*, of course, is the infinitive. *Answer my life my judgment* is a similar construction. 'Let my life,' Kent means, 'be a pledge of the truth of my opinion,' or, in other words, 'I will stake my life that what I say is true.'

Strengths, for 'strong men,' affords an illustration of the use of an abstract for a concrete noun. It is only when its meaning has become concrete (*i.e.*, when the word is no longer the name of a quality, but rather of something in which that quality exists) that an abstract noun can take the inflexion of the plural. By '*younger strengths*,' then, King Lear means men who are younger and stronger than himself.

Nursery (from the Latin) means here care and attention in general, and is not necessarily restricted to help in sickness. By *plainness*, Kent means 'plainness of speech,' that out-spoken tru hfulness that is generally so distasteful to an absolute ruler.

Champains = plains, or level country. This word reaches us through the French, and is derived from a Latin word, *campania*. *Campania* (except as the name of a province) is not to be met with in classical Latin, but is found among the works of Roman architects and surveyors.

Doom means 'sentence' or 'decision.' This will be easily remembered from the lines of Sir Walter Scott:—

> 'Whose *doom* discordant neighbours sought,
> Content with equity unbought.'

Miscreant meant, at one time, 'a misbeliever.' This word has undergone what Trench calls 'deterioration'—that is, it now stands for something worse than it did originally. It illustrates the fatal facility with which we ascribe whatever is morally wrong to those who differ from us in opinion. As regards the derivation, *creant* represents the Latin *credentem* (the student is aware that French words are derived from Latin accusatives), and the prefix *mis* or *mes* (from Lat. *minus*) conveys the notion that something is done amiss. We may notice this in *médire*, *méfait*, *mépris*, etc. *Recreant* is another compound of *credere*. It means, literally, 'one who believes again,' *i.e.*, changes his belief or apostatizes, and afterwards, like *miscreant*, a person of wicked character. It is said, too, that *re-creant* had the meaning of one who recants or owns himself beaten in a duel or judicial combat, which, according to the notions of the Middle Ages, was equivalent to a confession of crime. *Clamour* (Lat. *clamor*) has here the simple, literal meaning of speaking out, without the accessory idea of speaking out too much. By *clamour* (as in the expression 'noise and clamour') we now mean noise of an objectionable character. This word affords another instance of 'deterioration.' *Diseases* (dis-eases) means simply 'discomforts,' or 'inconveniences.' *Dower* and *dowry* seem, in this Scene, to be used interchangeably, but in legal phraseology the former has a separate and special meaning. A woman's *dowry* is what she brings with her when she marries, *i.e.*, her fortune. Her *dower* is (or, rather, was, for modern legislation has caused it

almost to disappear) her right to one-third of the freehold property of her husband, in the event of his dying intestate. This right once extended to land which the husband had possessed and parted with, and was found to be a very serious restriction on the sale of land, so that various legal expedients and 'fictions' were resorted to to defeat it. The meaning of *argument* is here 'subject,' or 'theme' (Lat. *argumentum*), and *benison* = blessing, a doublet of *benediction*, from the Lat. *benedictionem*. 'Albany' means the northern part of our island, which is stated to have fallen to the share of Albanactus in the mythical division of territory among the sons of Brutus. Brutus and his offspring, however, we need hardly remark, have no place in authentic British history. In historical times, Albany seems to have been an unlucky title. It had been used for five different dukedoms in Scotland, and for three in the peerage of Great Britain, before the son of Queen Victoria was created Duke of Albany of the United Kingdom. In six out of eight cases the title was extinguished with the life of the first recipient. Among the bearers of this title were Darnley, the unhappy husband of Mary, Queen of Scots, the unfortunate Charles I. of England, and the exiled James II.

Milk of Burgundy may be compared with *waterish Burgundy*, which we shall meet with a little later on. Burgundy appears at that time to have been a fine pastoral district. It is now, of course, best renowned for its vintage, soil and sun alike contributing to the production of a more generous wine than other districts of France can boast of. Of what is Cordelia speaking when she says *according to my bond?* All that she means is, we fancy, her bounden duty, as no mention is made of any special promise to her father. *Make from the shaft* = 'get out of the way of the arrow.' In 'Julius Cæsar,' Shakspere writes, 'make forth,' where *make* clearly has the force of *to go*. We have searched vainly in the notes of the Clarendon Press edition for an explanation of *in thy best consideration*. The most natural explanation is, perhaps, 'after giving most careful consideration to the subject,' that is, after you have considered the subject most carefully. But '*your consideration*' is capable of both a subjective and an objective meaning, *i.e.*, it may stand for either 'the thought which you take,' or 'the thought which is taken of you.' Possibly, therefore, the words may mean 'for the sake of your own best interests.'

Election makes not up is apparently an elliptical expression. We have the phrase 'to make up one's mind.' Can we say that *election*, the abstract noun, is put for 'the chooser,' and that *makes not up* means 'makes not up his mind,' *i.e.*, arrives at no decision? If we say that *makes not up* means 'comes not forward,' the sense is much the same, viz., 'no choice is possible under the circumstances.' The general drift of the expression is clear enough. 'Choose, royal sir,' says Lear, and the duke replies, 'It can't be done,' or 'There is no choosing in circumstances like these.' But the precise meaning of each word is difficult to arrive at. There are a few passages in all writers of which it is impossible to give a thoroughly satisfactory explanation. The words *make such a stray* are obviously equivalent to 'wander so far,' and *your love* has, we think, the objective meaning, *i.e.*, it means 'love for you.' We may, therefore, paraphrase the whole sentence thus: 'I would not be so deficient in good-will towards you as to marry you to a woman whom I detest.' *Let us hit together* seems to mean 'Let us agree.' There are many people who, when thrown together, cannot 'hit it off.' The folios read, 'Let us sit.'

By *darker purpose* (*i.e.*, more secret design) Lear seems to mean the reasons by which the partition of his kingdom, which he had announced already, was to be regulated and carried into effect. *That self way* = that same way. *Self* was formerly used as a demonstrative adjective. Dryden writes '*that self moment*.'

Names my very deed of love = 'names or mentions truly what my love is.' *Very*, meaning 'real,' is from Lat. *verus*, and appears in the words of the Creed, 'Very God of very God.' *Blank*, in *the very blank of thine eye*, is explained as meaning the white circle in the centre of a target. Kent's exhortation, then, amounts to the same thing as 'keep me in view,' the irate old man having just exclaimed, '*Out of my sight*.' In *that little seeming substance*, modern editors regard *little* as being closely connected with *seeming*, so as to be equivalent to a compound word, 'little-seeming.' But in older editions we may find '*that little, seeming* substance.' If the latter view were correct, 'seeming' would mean *specious*, and the whole passage would be equivalent to 'that worthless though specious woman.' But may not *that little-seeming substance* (we have joined the two words by a hyphen) have simply the meaning of 'that little body'? Lear is bent upon showing his daughter every possible insult, and possibly indulges in a fling at her personal appearance. In her father's estimation the poor girl is now everything that is bad, and he may, perhaps, entertain the opinion that she is 'not much to look at.' Lear's rudeness shows itself again in that speech to Kent wherein he threatens the latter with death in case his 'banished *trunk*' were found in his dominions. *A still-soliciting eye* means 'a constantly begging look,' and reminds us of that expression in 'The Tempest' (I. ii. 229), 'The still-vex'd Bermoothes.' In *waterish Burgundy*, the epithet means, apparently, 'well-watered,' and, according to the map, Burgundy is perhaps the best-watered district of France. There is, however, a tone of contempt in the speaker's words, as though the epithet, which is literally true of the country, could be predicated in a metaphorical sense (*waterish* may mean 'poor,' 'spiritless') of its ruler. *Washed eyes* are 'eyes drowned in tears,' and *unconstant starts* may be paraphrased by 'sudden acts of waywardness.'

Brazed, proper, untender, mean respectively, 'hardened' (morally), 'good-looking,' and 'hard-hearted.' *Affect, owe*, and *digest* are severally 'to aim at' (and hence, prefer), 'to own,' and 'to take the management of.' *Owe* is the present tense of *ought*. *To owe* is often used in Shakspere in the sense of 'to possess.' *Owe* and *own* have the same origin, viz., the Anglo-Saxon verb *agan*, of which the adjective *own* is the perfect participle. *Digest* is from Lat. *digerere*. *Reverb* has a strange look, though we are familiar enough with *reverberation*. Is this a specimen of that large influx of words derived directly from the Latin, which, as Trench tells us, came in about the period of the Reformation, but of which, happily, a large number failed to take root in our language? This, by the way, is rather an interesting fact. In Queen Elizabeth's time the importation of Latin words was going on at such a merry rate that Sir Thomas Browne opined that in 'a few years men would not be able to understand English without first

learning Latin.' Some of these words are sufficiently amusing. Had they kept their ground, we might, for instance, be in the habit of calling woman's nature *mulierosity*, and a stonemason's trade *lapidifical*. *Stultiloquy* might now be the correct word to denote the 'hare-brained chatter of irresponsible frivolity,' and *sanguinolency* the stout man's habit of body.

By the way, who does not recollect that little poem of O. W. Holmes in which he makes such capital fun of this style of English? The poem is headed, 'Æstivation,' and is printed in that delicious book, 'The Autocrat of the Breakfast-table.' It is summer, and the town-imprisoned citizen is longing to view the country, where he may

> 'Carp the crude berries of the nascent vine,
> And bibe the flow of longicaudate kine.'

If any educated man or woman in this country has never read the 'Autocrat,' let him be hereby notified thereof. After this, his not having read it will be his fault, and not his misfortune only.

Interessed means, of course, *interested*. The verbs *interest* and *interesse* are precisely the same in meaning. The former, however, is derived direct from the Latin, the latter through the French. *Strangered* (like *neighboured*) is an anomalous word that is only in form a participle. *Long-engraffed* means *long-engrafted*, and *long-engraffed condition* = qualities of mind confirmed by habit. *Graff* is probably the older form, being derived from the French *greffer*. New verbs are sometimes formed from the participial forms of others; hence we have both *graff* and *graft*, *hoise* and *hoist*, and several others.

In the allusion to the Scythians (will the reader kindly substitute *the Scythians* for *Saturn* in the last article?) Shakspere only echoes certain popular beliefs respecting the customs of distant nations. It is scarcely likely that cannibalism prevailed among these hardy tribes (before whose irruption even the Assyrians and Medes were wont to tremble), and that, too, of such a revolting sort as is indicated by the expression *makes his generation messes*, or, in other words, 'devours his own children.' National enmities and travellers' tales have a great many misapprehensions to answer for.

Belief in astrology (the *false* science of star-watching) was common enough in Shakspere's age, and he constantly refers to it.

Here Lear speaks of *the orbs from whom we do exist and cease to be*. Some of the finest lines in 'Julius Cæsar' are those which embody that belief. For a transposition of *only*, the reader may refer to the passage beginning *Only we shall retain*. The sense requires it to be joined, not to *we*, but to *name*, in the line following. *Only* is a word that is constantly misplaced, and the consequence is much obscurity of meaning. It should, if possible, be placed in immediate juxtaposition with the word it is intended to modify.

The folio and quarto editions of this play differ in many places as regards the text. Among many other instances, we have *shadowy* and *shady* (in line 55), *conferred* and *confirmed* (73), *interess'd* and *interest* (76), *freedom* and *friendship* (173), *regards* and *respects* (231), etc., etc.

Two explanations are possible of the line, '*And well are worth the want* (sc. of that?) *that you have wanted*.' The first is, 'You well deserve to lose the dower that you have been deprived of.' With regard to the meaning of 'to want,' Malone quotes from Stowe's 'Chronicle,' 'Anselm was expelled the realm, and *wanted* (lost, went without) the whole profits of his bishoprick.' May we not, however, consider the line as an example of the 'cognate accusative'? If this view be correct, then 'to want a want' is the same as to experience it. An alternative paraphrase, therefore, is, 'You well deserve the deprivation that you have experienced.'

In *who cover faults*, etc. (273), the so-called antecedent is put *after* the relative. Constructions such as this seem to show the inaccuracy of the term antecedent, which means 'that which goes before.' Perhaps 'correlative' would be a better term.

We had almost overlooked that strange expression (line 65), *the most precious square of sense*. One editor explains this as meaning 'the astrological square of the twelve houses, or diagram of nativity, that was common in old almanacs,' and suggests that this stands for 'a most fortunate man.' But how very far-fetched all this is! It seems much more likely that the speaker means the human body. The square, we know, is an emblem of (1) completeness, (2) moral perfection. One critic has suggested that the 'square of sense' means 'the full complement of all the senses'; and we believe the passage means simply, 'all pleasures of which our precious faculties are productive, when at their best.' The suggestion of Warburton, that the square of sense means the four nobler senses (*i.e.*, seeing, hearing, taste, and smell), seems to us, at least, more ingenious than probable. But, after all, the text may be corrupt. One edition has *spirit* for *square*. Elsewhere some one asks, 'Can *square* be for *sphere*?'

(To be continued.)

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Animal Physiology.

BY ARTHUR NEWSHOLME, M.D., AND C.S.S. (LOND.)

Nutrition and Metabolism.

We have in former chapters considered the digestive and circulatory functions of the human organism. In subsequent chapters, the excretory functions of the skin, lungs, and kidneys, will be studied. But none of these can be said to be master functions. We do not live to breathe or eat; we breathe and eat in order that higher functions may be efficiently performed. The nervous and muscular functions are above all others the most important. It is in the nervous system and the muscles that most of the energy derived from food is expended; and the other functions of the body may be regarded as subsidiary to the efficient working of these.

This being the case, we should expect that functional activity of the brain or muscles would be followed by increased elimination of products known to be derived from the brain (as phosphates) and muscles (as carbonic acid) respectively, and this has been repeatedly demonstrated.

The problem we now are concerned with, is to connect the elaborated food which enters the circulation, with the final excretory products which are cast off by the lungs, kidneys, and skin. These excretory products are, broadly speaking, carbonic acid, urea, and water. Water represents the water which was taken

as such in beverages, the water which enters into the percentage composition of all solid foods, and the water which has been derived by oxidation from fats and other foods which contain hydrogen in an incompletely oxidised condition.

Carbonic acid is derived through many intermediate changes from the carbon which enters into the composition of all foods, whether albuminoids, fats, or amyloids.

Urea is formed from the nitrogenous part of albuminoid food and tissues. The changes resulting in the final production of these excretory products are known as the metabolic functions, and it is during such changes that all the energy of the body (as heat, mechanical movement, and nervous functions) is developed.

Definition of Metabolism.

Only in a few instances can we localise the metabolic changes, the most important of these being the changes undergone in the production of glycogen in the liver.

History of Glycogen.

Glycogen is stored up in the hepatic cells as a reserve fund of carbohydrate material, just as in the vegetable world starch is stored in roots or tubers until the requirements of growth and development lead to the change of the starch into soluble carbohydrates, and its circulation to the parts of the plant where it is required.

The most rapid increase of hepatic glycogen occurs when saccharine or starchy food is taken; but the liver cells have the power of producing it, or the closely allied sugar, by the breaking down of albuminoid food (probably into urea and sugar). This is proved by the fact that in diabetes mellitus, a disease in which large quantities of sugar are passed in the urine, the total withdrawal of carbohydrate food does not entirely prevent the formation and elimination of sugar.

The close dependence of the glycogenic function of the liver on the influence of the nervous system is shown by the artificial production of glycosuria (saccharine urine) by puncture of a particular point in the medulla oblongata.

The study of glycogen in the liver throws great light on all metabolic functions. In this organ we see that glycogen (a sort of animal starch) can be produced from all carbohydrate foods; and also from albuminoid foods by their breaking up into a urea moiety and a sugar or glycogen moiety.

The subsequent history of glycogen in the system has not been so clearly worked out. According to some authorities, the glycogen leaves the liver as such by the hepatic vein; but most authorities agree that it is first changed into glucose, and then leaves the liver in an amount proportionate to the requirements of the system.

Where Carbonic Acid is formed.

The difference between venous and arterial blood consists almost entirely in the larger amount of carbonic acid and the smaller amount of oxygen in the former. This difference is particularly marked in the venous blood leaving muscle. Each contraction of a muscle leads to the production of considerable carbonic acid. The definite results of Dr. Edward Smith's experiments may be quoted. In walking at the rate of two miles an hour, the elimination of carbonic acid during an hour was equal to the quantity produced during 1¼ hour of repose with food, or 2½ hours of repose without food. Walking at the rate of three miles per hour for one hour was equal to 2¾ hours with, and 3½ hours without food.

The production of carbonic acid is not limited to the muscles; the venous blood leaving nearly every organ is richer in carbonic acid than the arterial blood entering it. But there is every reason for thinking that the amount of carbonic acid produced in the muscles is much greater than that produced from all other organs.

It might be imagined that as we have oxygen going to a muscle in the arterial blood, and carbonic acid leaving it in the venous, the change is one of direct oxidation in the substance of the muscle. Nature's chemical processes are, however, by no means so simple as this view would lead one to conclude. When a frog's muscle is removed from the body, no free oxygen can be obtained from it by an air-pump. Yet such a muscle will continue producing carbonic acid even while at rest, and when it is made to contract by electrical stimulus the amount produced suddenly and greatly increases. One must infer that each muscle stores up in certain chemical combinations the oxygen which is brought to it by arterial blood, and thus can go on producing carbonic acid for a considerable time after the supply of oxygen is removed. In other words, the oxidation process occurs not in the blood, but in the tissue itself. Of course, this production of carbonic acid can only go on in the absence of food and of oxygen, until the stored-up explosive compounds built up by the oxygen are exhausted, until in other words the vital clock has run down.

What is the nature of the intermediate processes between the disappearance of oxygen in the substance of the tissues and the evolution of carbonic acid from them is unknown. The intermediate processes belong to the general function of nutrition and metabolism, with the intimate character of which we are unacquainted. It would be a crude and unsatisfactory generalisation to assume that the process is identical with that of combustion. The only direct point of analogy between metabolism and combustion is that carbonic acid is the ultimate product in both. In metabolism, however, many intermediate steps are taken, the last of which only is the formation of carbonic acid.

The History of Fat.

It might naturally be imagined that the fat contained in various parts of the body is derived from the fatty food, which has been emulsified and alkalised in the alimentary canal, absorbed by the lacteal vessels, and carried with the blood to every part of the system. If this were so, we should have the kind of fat deposited varying with the food, which is not the case. Each animal has its own peculiar fats, which it forms whatever kind of food is supplied.

Long ago, Liebig demonstated that the amount of butter in cow's milk was much greater than could be accounted for by the scanty fat contained in grass or other fodder. Similar observations on pigs, whose digestive apparatus closely resembles that of man, have shown that a greater weight of fat is deposited than could be supplied from any fat in their food.

It is evident, therefore, that *fat is manufactured* in the organism. The only possible sources of such manufactured fat are carbohydrate food (amyloids, starch and sugar) and albuminoids. From a chemical

standpoint it is difficult to understand how sugar could be elaborated into fat. As a matter of observation, however, an increase of saccharine food is one of the most efficient means of producing an accumulation of fat. During the period of grinding the cane on sugar-cane plantations, the labourers become exceedingly fat from eating large quantities of the sugar. Again it is well-known that abstinence from starchy and sugary foods favours leanness. In the case of the Strasburg goose, which is kept penned up in a warm room and fed entirely on barley-meal, in order to produce the enormous fatty liver for the delicacy termed *pâté de foie gras*, we have apparently another instance of the same transformation of amyloids into fat.

Another explanation of these facts is, however, possible. It may be that the carbohydrates form a ready and convenient source of heat (through oxidation), and that their oxidation saves the less easily oxidised fats from metabolism, and allows the accumulation of the latter in the tissues. It is difficult to decide absolutely between these two views, but the weight of evidence is against the origin of fats from carbohydrates.

Fat from Proteids.

The origin of fat from albuminoids is a demonstrable fact. Urea, which represents the ultimate excretory stage of albuminoids, contains three times as much nitrogen and only two-fifths as much carbon as the albuminoid from which it is derived. Evidently, therefore, the metabolism of albuminoids leaves a non-nitrogenous moiety, which might remain as fat. More direct evidence can be obtained by microscopical examination. The protoplasm of connective-tissue corpuscles becomes changed into fat granules; and cells, showing the various stages in the change, can often be seen. In the secretion of milk, the transformation of protoplasm into fat

Secretion of Milk.

can be demonstrated. The epithelial cells of the mammary gland can be seen crowded with fat granules, which are discharged into the channels of the gland by the breaking up of the individual cells, or possibly by contractile extrusion, somewhat after the fashion in which an amœba rejects indigestible particles. The quantity of fat in milk is largely and immediately increased by the ingestion of proteid food, while it is not increased, but actually diminished by fatty food. This, as will be subsequently explained, is due to the fact that proteid food increases metabolism, while fatty food tends to diminish it.

It is interesting to note, as shedding light on metabolic phenomena, that the other chief constituents of milk, casein and lactose (milk sugar) are formed in the mammary gland by the activity of its protoplasmic cells, and not simply filtered from the blood. Casein does not exist as such in the blood, and there is no lactose anywhere in the human system except the mammary secretion. The history of lactose in the mammary gland illustrates in another organ the formation of a carbohydrate from proteid food (for milk is best produced on a nitrogenous diet). The formation of glycogen in the liver, when a strictly meat diet is maintained, will be remembered; and the two cases are strikingly alike.

(To be continued.)

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Recent Inspection Questions.

Arithmetic.

STANDARD I.

(Nos. dictated.)

(1) Add 404, 780, 6, 900, 888. 2978. Ans.

(2) From 802 take 23. 779. Ans.

(3) From 693 take 214. 479. Ans.

(4) Each child was asked three or four questions in the multiplication table up to 6 times 12.

STANDARD II.

(Nos. dictated.) *A.*

(1) 47,685 × 94. 4,482,390. Ans.

(2) 43,548 ÷ 5. $8709\frac{3}{5}$. Ans.

(3) 88,747 ÷ 11. $8067\frac{10}{11}$. Ans.

(4) From 87,006 take 9219. 77,787. Ans.

B.

(1) 49,867 × 94. 4,687,498. Ans.

(2) 48,575 ÷ 6. $8095\frac{5}{6}$. Ans.

(3) 84,755 ÷ 12. $7062\frac{11}{12}$. Ans.

(4) From 649,307 take 249,908. 399,399. Ans.

STANDARD III.

(A Card.)

All the numbers were in words.

(1) Add £69,382 17s. 6d., £2948 12s. 3¼d., £98 13s. 5¾d., £79,402 8s. 0½d., £3824 12s. 5¼d. £155,657 3s. 8¾d. Ans.

(2) From £69,281 15s. 8¼d. take £2708 16s. 7¾d. £66,572 19s. 0½d. Ans.

(3) Divide 8,632,564 by 79. $109,272\frac{16}{79}$. Ans.

(4) Two bags contained 714 nuts. The second contains half that number. If 86 were taken from each bag, how many will remain? 542. Ans.

STANDARD IV.

(A Card.)

(1) £84 17s. 3¼d. × 117. £9929 0s. 8¼d. Ans.

(2) £12,060 17s. 6¼d. ÷ 79. £152 13s. $4\frac{1}{2}$ $\frac{3}{79}$d. Ans.

(3) Reduce 25,040 lbs. to tons, cwts., qrs., etc. 11 tons 3 cwt. 2 qrs. 8 lbs. Ans.

(4) A man buys 27 horses for £400, and sells them at 19 guineas each. How much does he gain or lose by the transaction?

He gained £138 13s. 0d. Ans.

STANDARD V.

(A Card.) *A.*

(1) Find the value of 3142 articles at £1 17s. 10½d. each. £5946 17s. 9½d. Ans.

(2) How many lbs. of sugar at 4½d. per lb. are equal in value to 36 lbs. of coffee at 1s. 7d. per lb.? 152 lbs. Ans.

(3) Make out a bill for 27¼ lbs. of beef at 9d. per lb., 6½ lbs. of pork at 7d. per lb., 12 oz. of suet at 10d. per lb., 10 lbs. 8 oz. of bacon at 11d. per lb.

(£1 0s. 5¼d. + 3s. 9½d. + 7½d. + 9s. 7½d.)

= £1 14s. 5¾d. Ans.

(4) What must be added to $\frac{11}{16} - \frac{1}{4}$ to make it equal to $\frac{2}{3} + \frac{1}{5}$? $(\frac{2}{3} + \frac{1}{5}) - (\frac{3}{8} - \frac{1}{4}) = \frac{55}{120}$. Ans.

B.

(1) Find the value of 12 acres 3 rds. 26 poles at £6 10s. 0d. per acre. £83 18s. 7½d. Ans.

(2) Make out a bill for 7½ yds. of calico at 9½d. per yd., 4¼ yds. of ribbon at 3d. per yd., 8 doz. reels of cotton at 6½d. per doz., 2½ yds. of flannel at 1s. 7d. per yd.

(5s. 11¼d. + 1s. 0¾d. + 4s. 4d. + 3s. 11½d.)
= 15s. 3½d. Ans.

(3) If 15 horses can plough a field in 7½ days, how many horses can do it in 22½ days?

5 horses. Ans.

(4) A boy gave ¼ of an apple to each of his three sisters and ⅙ to his brother. What fraction of the whole had he for himself? $1 - (\frac{3}{4} + \frac{1}{6}) = \frac{1}{12}$. Ans.

STANDARD VI.

(*A Card.*)

(1) Find the difference between 6·250 of 4s. 4d. and ·06̇ of 15s.

6·25 of 4s. 4d. − ·06̇ of 15s.
= 6¼ of 4s. 4d. − 1/15 of 15s.
= £1 7s. 1d. − 1s.
= £1 6s. 1d. Ans.

(2) $\frac{7}{14}$ of a ship is worth £1260, what is $\frac{1}{30}$ worth?

$\frac{7}{14} : \frac{1}{30} :: £1260 : £196$. Ans.

(3) Find the value of ·375 of 2 days 10 hours 24 minutes.

·375 of 2 days 10 hours 24 mins.
= ⅜ of 2 days 10 hours 24 mins.
= 21 hours 54 mins. Ans.

(4) The dimensions of a room are 29½ ft. by 11¼ ft, how much carpet ⅝ yards wide will cover it?

$29\frac{1}{2} \times 11\frac{1}{4} \div \frac{5}{8}$ yards.
$= \frac{59}{2} \times \frac{45}{4} \times \frac{8}{15}$
= 59 yards. Ans.

STANDARD VII.

(1) What sum of money will produce an interest of £281 5s. in 5 years at 4½ per cent.?

£ £ s. £ £
5 × 4½ : 281 5 :: 100 : 1250. Ans.

(2) Find the average of 27,056, ·0003, ·1, 0, 500, ·0057, 3·1416, 1·9999, 0, 72,756.

10,031·72475. Ans.

(3) A man walks 2½ miles in 40 minutes, how long will he take to walk 40 miles 3 furs. 10 pls., if the ratio be increased as 10 is to 12?

m. m. f. p. mins. hrs. ms. secs.
2½ : 40 3 10 :: 40 : 8 58 45. Ans.
12 : 10

(4) A mixture of tin and copper, of which 65 per cent. of the whole is of the former metal, find what weight of each is in 3½ tons of the mixture.

tons tons cwt. qrs.
100 : 65 :: 3½ : 2 5 2 tin. Ans.
100 : 35 :: 3½ : 1 4 2 copper. Ans.

Dictation and Composition.

STANDARD I.

Words dictated.—Rain, rest, men, return, day, open, very, wet, come, bath.

Transcription.—'Sometimes I am soft.'

STANDARD II.

I think he means, why do men build their houses so close together? and why do people wish to live so near each other? There are many reasons. One is for the sake of the company. Friends like to live near each other. Another reason is, when men live in one place they can help each other.

STANDARD III.

They were out on the sea, *paddling round* and round the dear old ship to try what they could find; no doubt I was so busy watching them that I *never* heard a sound till a bough *touched me*, and then I looked up, and there stood a woman, a *savage* woman with her blanket over her, and her bare arms covered with clumsy *bracelets*.

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The merchant mused for a while, and then said, 'Perhaps I can aid you in getting into something better. I am president of a new projected railroad, and we are about to put on the line a company of engineers for surveying and locating a route. You studied surveying and engineering at school at the same time as I did, and, I suppose, have still a correct knowledge of both.'

STANDARD V.

My eldest son I intended for one of the learned professions. My second boy, Moses, whom I designed for business, received a sort of miscellaneous education at home. But it is needless to attempt describing the particular characters of young people that had seen very little of the world. In short, a family likeness prevailed through all, and, properly speaking, they had all one character—that of being all equally generous, credulous, simple, and inoffensive.

STANDARDS VI. AND VII.

Write a composition on 'A tree,' 'Richard II.,' or 'Evangeline.'

Grammar.

STANDARD II.

Pick out four nouns and four verbs from the piece given for Dictation.

STANDARD III.

The children were told to underline the words printed in italics in the Dictation, and then to tell the part of speech of each.

STANDARD IV.

Parse words in italics:—

'A weary *man with* dusty *feet*
Came slowly down the village street.'

STANDARD V.

Parse and analyse:—

'Then o'er the mushroom's head
Our table-cloth we spread.'

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Parse and analyse :—

'He does me double wrong
That wounds me with the flatteries of his tongue.'

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'Say, Scroop, where lies your uncle with his power.'

Geography.

STANDARD II.

What is an island? Are there any islands in this neighbourhood? Say where. If men made a bank of earth, joining it to the mainland, what would the island be called now? What is the name of the bank of earth? What is the name given to a flat piece of land high up among mountains? What do you call a flat, *low* tract of country? What do you mean by a continent? How many continents are there? Name them. Which is the largest? Which the smallest? Which the island-continent? Which do we live in? What do we call the people who live in Europe? What is an ocean? Name the ocean nearest to us. Which are the coldest? What is a gulf? Name some gulf. What seas are around England? Sometimes two seas are joined by a narrow neck of water; what do we call it? Give some other names. What is a channel? Name one. What is a cape? Give other names for a cape. What do we mean by the source of a river? How many banks has a river? How can we tell the right bank from the left? What is a confluence? Name some English rivers. Nearly all the rain that falls for miles around flows into the river; what do we say the river does? Explain the meaning of watershed. What are watersheds made of, mountains or plains? Where do rivers generally rise? How is that? What rivers do you know that have deltas? What is an estuary? What shape is the earth? How can you prove that the earth is round? (four proofs required). What do we call the distance round the earth? What is the length of the circumference? The diameter?

STANDARD III.

What is on the south of the English Channel? How do you know which is south? Name the range of mountains in the north of England. How far south does it extend? Name its highest point. What other mountains are there in the north? Name the peaks in them. Name the highest point in England and Wales. Highest point in the world. Name the hills of England in order. Name the lakes among the Cumbrian mountains. Name one cape in Wales. One lake in Wales. Rivers draining the counties on the west of the Pennine Range. Largest river in Wales. In England. Where does the Severn empty itself? Name of river separating Lancashire from Cheshire? What town on the Mersey is in Lancashire? Name the town opposite Liverpool. Another large town in Lancashire. Name the cotton towns. Largest town in Yorkshire. Name woollen towns. What kinds of woollen goods are made at Leeds? Where is Welsh flannel made? Where is Birmingham? What is it noted for? Name any towns where lace is made. Where is Honiton? What is the difference between Honiton and Notts lace? Why do people use machines? Where is glass made?

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What is the great mountain range of Scotland? Highest point and height? What lakes are joined by the Caledonian Canal? Name the towns at northern and southern entrance to canal. Name the hills of Scotland in order. Name the great river on the west. Towns on that river. Name islands of Scotland. Seaport for Edinburgh. What river is Dundee on? What is the river noted for? Name the Scotch rivers flowing into North Sea. Name the lakes of Scotland. Largest. Manufactures of Scotland. Where are the mountains of Ireland, generally speaking? What is the nature of the centre? What do people get from bogs? Name the highest mountain in Ireland. Rivers on the south. Manufactures. In what province and county is Dublin? What other town is there on Dublin Bay? Name exports of Ireland. Largest river. Lakes formed in its course.—A few questions were then put by the teacher on British North America.

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What strait separates England from France? French name for the same. What are the chief exports of France? and Spain? Where does River Rhine rise? What lake does it flow through? What is the name of the falls? Town where it bends northwards? Where are Mayence and Coblentz? Name of fortress at Coblentz? What is Cologne noted for? (Cathedral.) How long did it take to build? When completed? Where does Danube rise? In what state? When Danube leaves Baden, what state does it flow through? What next? Name of delta? Towns on Danube? Town of Russia on Black Sea? Name largest river in Europe. How long? Where rises? Where empties its waters? What do we get from South of Russia? Capital of Russia? On what river? Why is it a bad position for a capital? Why does Baltic freeze quickly? Where is Copenhagen? Name a sound on English coast? What is the name of peninsula in Denmark? Name of cape at the north of it? What is esparto grass? Where obtained from? What used for? Highest mountain in England and Wales? In Europe? In the world? Height of each in feet? Rivers and exports of Italy?

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What are the most striking physical features of North America? If you were in U.S. what large river would you be likely to see? What is the watershed on the east of this river? Mountains of South America? Name a few peaks. Where in South America do we obtain silver and other valuables? What does Santiago mean? Name chief towns of America. Capital of China. Rivers. Name highest mountains of India. Highest point. Capital, and the river it stands on. Name other rivers of India. What are the people of Ceylon called? Name three towns on Suez Canal. Name country at south of Africa. Capital of same. Mountains. Island on East of Africa. Channel between it and mainland.

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EVER TO THE RIGHT.

With spirit.
1st TREBLE.
2nd TREBLE.
BASS.
1. Ev - er to the right, boys! Ev - er to the right! Give a rea - dy
2. Ev - er to the right, boys! Ev - er to the right! Du - ty nev - er
3. Ev - er to the right, boys! Ev - er to the right! Ear - nest be at
KEY G. f With Spirit.
hand and true, To the work you have to do: Ev - er to the right, boys!
try to shun, Faith - ful be to ev - 'ry one: Ev - er to the right, boys!
work or play, Drive all e - vil thoughts a - way: Ev - er to the right, boys!
D.t.
Ev - er to the right! To each stu - dy well at - tend; Let each school-mate
Ev - er to the right! Speak the truth, the right pur - sue, Hon - est be in
Ev - er to the right! Time is gold, do what you can; Make your mark, and
f G.
be a friend: Ev - er to the right, boys! Ev - er to the right!
all you do: Ev - er to the right, boys! Ev - er to the right!
be a man: Ev - er to the right, boys! Ev - er to the right!

Notes of Lessons on Ocean Currents.

BY JOS. H. COWHAM, F.G.S.,

Lecturer on School Method at the Westminster Training College.

MOVEMENTS OF WATER. Part III.

Lesson on the Work done by Tides, Currents, and Waves.

INFORMATION.

A. The Tides:—

1. The ebbing and flowing of the tide in an estuary prevent the accumulation of mud in the channel. The ebb tide carries the finest detritus out to sea. Thus **tidal rivers are generally navigable.**

Examples of rivers entering:—

(*a*) A Tideless Sea.	(*b*) A Tidal Sea.
Nile ... unnavigable	Thames ... All navigable for large ships.
Rhone ... impeded mouth	Tyne ...
Po... ... unnavigable	Elbe ...
Danube, Volga: navigable, but not for large ships	Severn ...
	Shannon...

2. Tidal action prevents the formation of ice in the harbours and narrow seas of the North Temperate Zone. It does this in two ways.
   (*a*) By keeping the water in motion.
   (*b*) By mixing the salt sea water with the fresh water of the rivers. Salt water rarely freezes in our seas.

3. River traffic is assisted by the tidal movements of the water in an estuary.
   Town refuse is carried out to sea by the outward movements of the ebb tide.

B. Currents:—

1. The climate of countries adjacent to warm currents is made milder by their approach. Cold currents chill the shores near them.

   Examples:—(1) Western Europe has mild winters in consequence of the Gulf Stream and its continuation northwards to Norway.
   (2) British Columbia has a mild winter, due to the approach of the Japan Current.
   (3) Labrador, Nova Scotia, and the New England States have very cold winters. The Arctic Current washes their eastern shores, and chills the air above it.

2. Currents effect an interchange between the warm tropical waters of the equatorial regions and the cold Polar waters.

3. They help to maintain the uniform saltness of the sea, and the purity of its water.

4. Ships take advantage of currents as far as possible when shaping their courses across the ocean.

EXAMPLES, ILLUSTRATIONS, Etc

Fig. 1. Example of a river entering a tideless sea.

Fig. 2. A tidal river with a navigable mouth.

(2) Refer to the Baltic Sea, and contrast with the state of the harbours along the shores of the North Sea and English Channel.

The Baltic ports are closed during the winter months by ice. The ports along the English coasts are always open.

(3) Draw attention to the barges which float up and down the river on the tide.

The purification of the river by the tide might be illustrated by the flushing of a drain.

Fig. 3. Represents the shallow but warm Gulf Stream amidst the colder waters of the Atlantic Ocean. The rapid cooling of the water on the western side is due to the approach of a cold current which runs between the Gulf Stream and the mainland.

State the facts enumerated in the examples, and show on a sketch map the position of both countries and ocean currents. See Practical Teacher, Dec., 1885.

(2) Refer to Carpenter's experiment in the lesson on Ocean Currents in the Practical Teacher, January, 1885.

(3) Refer to the Mediterranean Sea, which is not connected with the great ocean currents. The water is much above the average saltness.
Contrast with this the water in equatorial regions where, in consequence of evaporation, the salt might be supposed to accumulate. The constant movement prevents this increase in saltness.

(4) State the course of a ship bound to Melbourne:—Why does it cross the Atlantic towards Rio? What currents will it follow from near Rio?

C. **Waves, Tides, and Currents :—**

1. In previous lessons it has been shown that waves and breakers are the chief agents of cliff destruction.

   The pebbles and boulders which are hurled by the breakers against the cliff assist in wearing away the coast.

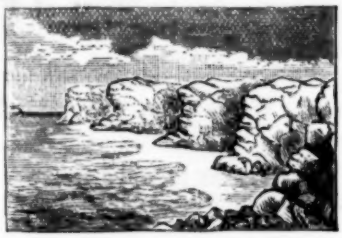

Fig. 4. Example of cliff destruction.

2. The Tides change the level at which the waves act, so that the range of wave denudation on a coast extends from a short distance below low tide to a little above high tide.

(2) See diagram of high and low tide in previous lesson (PRACTICAL TEACHER, Feb., 1886).

3. The *débris* worn down by waves and breakers is carried away by tides and ocean currents, and deposited in the deeper portions of the ocean bed.

   Thus it is seen that **Waves, Tides, and Ocean Currents aid each other in the destruction of a line of bold coast.**

(3) Teach by contrasting the effects if waves acted alone. The fallen *débris* would accumulate in front of the cliff, and protect it from further attack.

BLACKBOARD SKETCH.

Work done by Tides, Currents, Waves.

1. TIDES. (*a*) Wash out channels in river estuaries.
   (*b*) Keep harbours free from ice.
   (*c*) Assist traffic, and clear away sewage.
2. CURRENTS. (*a*) Affect the climate of a country.
   (*b*) Tend to equalise the temperature of the ocean.
   (*c*) Maintain the ocean's uniform saltness and purity.
3. WAVES, TIDES, and CURRENTS assist each other in cliff destruction.

Science Notes.

THE Royal Society is, at the present time, making an urgent appeal to increase the Scientific Relief Fund to £20,000. Sir William Armstrong has made a most generous offer of £6000, provided that an equal sum be raised within the current year. We all owe much to the scientific workers of the past. Our present position, our immunity from many of the ills that flesh is heir to, and our future expectations depend largely upon the persevering efforts of men whose zeal occasionally goes beyond the bounds of discretion. Health, prospects, family claims are sometimes disregarded in the eager pursuit of truth. The time, we trust, is fast coming, when no man without means will think of marrying until he has insured his life. One fertile source of distress will then have ceased to exist.

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THOSE who have access to a good library should not fail to turn over the pages of Scribner's Statistical Atlas of the United States. Teachers would be especially interested in the section on education. The work is too expensive (eight guineas) to bring it within the reach of the general public. We may, however, fairly promise those who can get a glimpse of this splendid atlas, that they will carry away with them a new idea of the attractiveness and force that may be given to mere figures by a proper use of form and colour. Teachers would find much in the methods employed that they could turn to practical account.

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THE wind in a late storm in America blew at the enormous rate of over 80 miles an hour, a higher figure than any before recorded there. In a calm the wind moves at 3 miles an hour, in a light breeze at 13, in a fresh breeze at 28, in a moderate gale at 40, and in a strong gale at 56. The pressure of the wind, when the wind is moving at 13 miles per hour is 2·7 lbs. per sq. foot, at the rate of 28 miles it is 6·9 lbs., at 40 miles it is 14·2 lbs., at 56 miles 27·8 lbs., and at 75 miles it becomes 50 lbs. per sq. foot. The effects, therefore, of such a gale can be understood, especially when we remember the damage done in this country by much less violent winds.

***

A NEW process of bleaching was patented some time ago by J. B. Thompson. The principles of it, as explained at the time by the author, were these. Bleaching powder when acted upon by carbon dioxide, yields chlorine and calcium carbonate. The nascent chlorine thus liberated decomposes water, forming hydrogen chloride and sets oxygen free to bleach the goods. The hydrogen chloride can be used again to decompose the carbonate, and thus yield a fresh supply of carbon dioxide. Our readers will, no doubt

recall the ammonia soda process, which furnishes a similarly complete cycle of reactions. It seems that it is in thus using the immediate products over and over again that economies in production will have to be effected. Competition is now so keen that processes which allow materials to be employed continuously, instead of performing their whole function at once, are certain to find favour in this age of the survival of the fittest.

Messrs. Cross, Bevan, and Mather have all assisted in improving what is now believed to be the most complete and perfect bleaching process known. Much time will be saved; what formerly took forty hours can now be done in twelve. There will also be a considerable saving of expense. It is not to be wondered at, therefore, that the success of the new process has caused considerable excitement in the bleaching trade.

***

Professor Jowett has just published a new translation of Aristotle's 'Politics.' The number of those who can read the original must always be comparatively few, nor in this case is that so much to be regretted. The works of Aristotle, the professor tells us, are almost entirely wanting in the charm of style, and some of them cannot even be said to have the merit of clearness. Those who have read Professor Jowett's 'Plato' will not need reminding that his writings possess the charm of style and the merit of lucidity also. Many of our readers would be much interested in parts of Books VII. and VIII. of the 'Politics,' where Aristotle treats of education. There was no science of education in his day, and his handling of the subject is necessarily incomplete.

Aristotle thinks that children up to five years of age must learn nothing, but only play. Their games should be miniature representations of after life. Children should not be left too much with slaves, and should not be allowed to hear anything improper, for shameful words are parents of shameful acts; they should only see what is good, and should be strangers to vice in every form.

The branches of education Aristotle says are (1) reading and writing, (2) gymnastics, (3) music, (4) drawing. (1), (3), and (4) are of practical importance; (2) is for the proper employment of leisure. But the practical branches should be studied with a high purpose. To be always seeking after the useful does not become free and exalted minds. The education of the body should precede that of the mind, but even in physical exercises there must be moderation. Courage is not to be sought for alone. It is to be associated with gentleness and nobility. The evil of excessive training in early life (the over-pressure of his day), as practised by the Spartans, is demonstrated by the fact that only two or three of them gained the Olympic prize, both as boys and as men.

Aristotle thought education should be public and adapted to the constitution of the state—an education which existed nowhere in Hellas, except at Sparta.

In many aspects of the question, very great advances have been made since the time of Aristotle. Can it be said that in some others we have made any progress at all?

—o—

Publications Received.

Blackie and Son—
The Principles and Practice of Teaching. By A. Park.
Vere Foster's Drawing Books. Sets A to Z.

Cassell and Co., Limited—
Cassell's National Library. Edited by Prof. Henry Morley.
Sermons on the Card. By Hugh Latimer.
Childe Harold's Pilgrimage. By Lord Byron.
My Ten Years' Imprisonment. By Silvio Pellico.
Warren Hastings. By Lord Macaulay.
The Man of Feeling. By H. Mackenzie.
The Autobiography of Benjamin Franklin.
The Rivals and The School for Scandal. By R. B. Sheridan.
The Complete Angler. By Isaac Walton.
Plutarch's Lives of Alexander the Great and Julius Cæsar.
Cassell's Pictorial Alphabet and Object Lesson-Sheet.

Curwen and Sons—
School Cantatas. By T. Mee Pattison.
'Freddy and His Fiddle.'
'Britannia and Her Daughters.'

Dawson (A. G.)—
Helps in English. By A. Park.
The Cheltenham Daily Register of Marks, etc.

Heywood (John)—
Analysis of the Gospel of St. John. By L. Hughes, B.A.

Longmans and Co.
Longmans' Magazine. March.
Beginnings in Book-Keeping. By Rev. J. Hunter, M.A.
Frictional Electricity. By Thomas P. Treglohan.

Philip (G.) and Son—
The Key Modulator. By J. Taylor.
Philips' Standard Map-Drawing Books, Nos. 1 and 2.

Simpkin, Marshall and Co.—
A Vocabulary of French Words Arranged on a New Plan. By M. E. Findlay, B.A., and J. J. Findlay, M.A.
An Etymological Index to Julius Cæsar. By F. C. Woodforde, B.A.

Smith, Elder, and Co—
The Cornhill Magazine. March.

Society for Promoting Christian Knowledge—
Photo-Relief Map of Scotland.

Swan Sonnenschein, Le Bas, and Lowrey—
An Analysis and Study of the Leading Characters of Hamlet. By Oxon.
History of the German Language. By H. A. Strong, M.A., LL.D., and Kuno Meyer, Ph.D.
Century Cards, English History, 1000–1882.
Charts of Ancient and Modern History. By W. Herbert Anderson, M.A.

Ward, Lock, and Co.—
Lessons in French. By Jules A. L. Kuntz.
Key to " " "

Warne, F. and Co—
Nuttall's Standard Dictionary. Revised by the Rev. James Wood.

—o—

The 'Practical Teacher' Sale and Exchange Column.

Owing to numerous requests, we have been induced to start this Exchange Column for the benefit of our readers. We shall be glad to insert announcements relating to the 'Sale or Exchange' of books, etc., at the rate of One Penny per Line, *prepaid.*

Wanted:—March, 1884, or No. 1 of Vol. IV., Practical Teacher. Will give 1s.—H. B. Score, Powerstock, Bridport.

What offers for Practical Teacher, Vols. I. to V. (complete); 'Currie's Common School Education'; 'Guardian,' in 2 vols.; 'Tatler,' in 4 vols. (date 1743), well bound in leather; 'Humphrey Clinker' (date 1831), 4 illustrations by G. Cruikshank. Singly or otherwise. Address, Master, Ivington, Leominster.

Query Column.

RULES.

1. Each correspondent is restricted to *one question.* We should be much obliged if correspondents, who send questions for solution, would give (if possible) the required answer, and the source from which the question is obtained.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. ☞ When a pseudonym is adopted it should be written at the end of the query, and the real name and address on a separate piece of paper.

4. Correspondents are requested to write their queries *legibly*, and on one side of the paper only.

5. Replies will not be sent through the post.

6. Queries must reach the office *not later than the 12th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed—'*The Query Editor*,' *The Practical Teacher, Pilgrim Street, Ludgate Hill, London, E.C.*

General.

1. MARY THOMSON.—You ask how verbs said to be in the potential mood are parsed by those who maintain that there is no such mood. The answer is quite easy. The verb, which was said to be an auxiliary verb indicating potential mood is parsed as a principal verb, and the verb with which it is joined is parsed as an infinitive mood governed by the verb, which would be otherwise parsed 'as an auxiliary.' You will find by and by that there are verbs in French, German, and Latin which exactly answer to our word 'can,' which are always considered to be principal verbs. In the case you name, parse, if you like, *may* as a principal verb, and then say: 'have loved is the perfect infinitive of love, gov. in the infinitive mood by '*may*.'

2. ALPHA.—

A. Prin. Sent.:
Subj.—Eternal Justice
Pred.—had prepared
Obj. D.—such place
Obj. Ind.—for those rebellious.

B. Prin. Sent., cop., co-ord. with A:
Subj.—(Eternal Justice)
Pred.—had ordained
Obj.—their prison
Ext. of Place.—here.

C. Prin. Sent., cop. co-ord with A and B:
Subj.—(Eternal Justice)
Pred.—had set
Obj.—their portion, removed as far from God and light of heaven.

D. Subord. Adverb. Sent. of comparison to C.
Connective.—as
Subj.—distance
Pred.—is there
Ex. of Extent.—from the centre thrice to the utmost pole.

Removed.—Comp. part of trans., weak verb, pass. voice, qualifying *portion.*

A. Prin. Sent.:
Subj.—I
Pred.—do not repent or change
Obj.—that fixed mind and high disdain from sense of injured merit
Ext. of Purpose.—for those nor for (*that*)

B. Adj. Sent., qual (*that*):
Subj.—The potent victor in his rage
Pred.—can inflict
Obj.—what else.

C. Subord. Adverb. Sent. of Concession:
Connective.—Though
Subj.—I
Pred.—am changed
Ext. of Respect.—in outward lustre.

D. Subord. Adj. Sent., qual. 'sense':
Subj.—That
Pred.—raised
Obj.—me
Complementary Obj.—to contend with the mightiest.

E. Subord. Adj. Sent., qual. sense, co-ord. with D.:
Subj.—(That)
Pred.—brought
Obj.—innumerable...armed
Ext. of Place.—along.

F. Subord. Adj. Sent., qual. 'spirits':
Subj.—That
Pred.—durst dislike
Obj.—his reign.

G. Adj. Sent. qual. 'spirits,' co-ord. with F.:
Subj.—(That) preferring me
Pred.—opposed
Obj.—his utmost power
Ext. of Instr.—with adverse power
Ext. of Man.—in dubious battle.
Ext. of Place.—on the plains of heaven.

H. Adj., co-ord with G.:
Subj.—(That)
Pred.—shook
Obj.—his throne

I. Prin. Sent. (elliptical):
Subj.—What
Pred.—can be done.

K. Subord. Concessive:
Connective.—Though
Subj.—the field
Pred.—be lost.

3. CARACTUS.—Art. 58 of the Code meets your case. The last school is expressly stated. Refer to the Code.

4. RICHARD.—(1) History, 'The Nineteenth Century,' *Mackenzie* (Nelson and Sons); (2) *Hewett's* 'Colonies'; *Mackay's* 'Elements of Geography.' Music is not among the grouped subjects; you can take it, if you like.

5. J. IRVING.—Read the whole of the lectures and the greater part of the 'Psychology.' If time fails you, you may omit chapters xi., xii., and xiii.

6. PARKINSON.—All usually-allowed abbreviations may be used, unless otherwise stated. (See page 31 in this PRACTICAL TEACHER.)

7. LEHRER.—We suppose you refer to the twenty-two weeks limit. Refer to the Code, 109, e II. It specially states the *last* 22 weeks that the school has been open.

8. X. L.—Professor Oliver tells you much more than you have put down. Get *Thome's* 'Botany' (Longman and Co.) 'First Lessons in Practical Botany,' by *G. T. Bettany*, 1s., might be useful. For geology, use *Jukes-Brown's* 'Text-book of Geology.'

9. GWYLYM PYWELL.—The map is excellent; you need not spend time in improving upon it, unless you like to use a coloured pencil or two, which adds to the effect. Beautiful maps were sent from France to the last Exhibition; they owed much of their attraction to the judicious use of colour.

10. SCHOLARSHIP CANDIDATE.—(1) Freehand, Model, Perspective, and Geometry; (2) (2nd Advanced) Physiography; Magnetism and Electricity (1st Elementary); (3) Yes.

11. WIGTONIAN.—Thanks. The error had not been noticed.

12. E. O. POTTS.—You will find the solution of your query in our issue for October, 1885.

13. R. DAWSON.—Thanks for your solution.

14. P. KLEEBERGER.—Your solution is more difficult than the one given. You have omitted several steps, and it is not easy to obtain the factor $\sqrt{(a+x)(a-x)}$ or $\sqrt{a^2-x^2}$.

15. H. R. L.—The Rev. C. F. Brown, St. Catherine's College, Cambridge, is secretary to the syndicate. Write for any information you may require.

16. W. R.—*Dr. Smith's* 'Roman History' (7s. 6d.) is very good, and will do admirably, or you can use the one you name. For Latin composition you can use Latin prose through English idiom, 'Principia Latina,' Pt. IV., or *Bradley's* 'Latin Prose Composition.' But in any case you will need some help in regard to your exercises. How shall you know when they are correct? There is a good edition of 'De Natura Deonem' (libri tres), by *J. B. Major* (10s. 6d.). The histories you quote are sufficient.

For 'The Twelfth Night' use Blackie's edition.

17. MALVOLIO.—Write to the War Office, Whitehall, London. You will then be told at once all you want to know.

18. JENISA.—We are glad you appreciate the Answers to the Matriculation Questions. If you refer to the prospectus for the new volume, in the February number, you will see that your suggestion has been anticipated. Answers will appear in due course.

19. HAROLD.—The small hand, 75; the large hand, 60. What you want is *Cowham's* 'Mulhaüser's Manual and Exercise Book,' which will be ready and advertised in a few days. You will find this meet all your wants.

20. EASINGWOLD.—(1) Yes; the marks will be added on. You can say you were examined. They will see that the marks are attended to. (2) Nobody can tell you. (3) There is no paper on mental arithmetic at the Scholarship. (4) Yes, but only a few notes. Small hand, 70; large hand, 60.

21. LEO.—Write to the Secretary, 130, Horseferry Road, Westminster, S.W. He will give you what information you want in more detail than we can. Do so at once, as you have not too much time for preparation. If you failed badly we should think you would not get in.

22. CÆSAR.—The writing is wretched for the purpose you name. You don't know how to form the letter O; or, indeed, any of the letters. Small hand, 25; large hand, 40. Get a good set of copies, and practise half an hour a day, and send another specimen in two months.

23. GILLIES.—Large hand, 40; small hand, 35.

24. PUPIL TEACHER.—Any good grammar tells you how to distinguish English words from those of foreign origin. See *Dr. Morris'* 'Elementary Lessons in Historical English Grammar,' page 27.

25. R. H. D.—We should say that all marks from whatever source obtained have the effect of putting you higher up on the list, and, therefore, of lifting you out of the second class into the first. Looking at the future, we should most strongly recommend you to continue your drawing. Learn the accidence of the languages. If you like you can give up the science, unless it bears directly on the matriculation, but that is doubtful.

26. UNCLE TOM.—British North America comprises all the provinces belonging to Great Britain. The Dominion of Canada comprises them all except that of Newfoundland. Canada comprises Upper and Lower Canada only.

27. K. GEO. FAGG.—You are right. A *third* class certificate can only be raised after two years. It is pleasant to hear you say that part of your success was due to the hints we gave you. It was no doubt due much more to the diligence with which you put them into practice. We take the liberty of sending you a few copies of the new prospectus for distribution among your friends.

28. WIGTONIAN.—Are you likely to be edified by the literature you inquire about? Take our advice, and commit some really valuable pieces to memory. We are glad we cannot tell you where to find the pieces you have named, and we hope you may not be able to get the information elsewhere.

29. A. H. Y.—We suppose you are working at the subject practically. In that case there are two books which will suit you very well—*Bloxam's* 'Chemistry' (last edition), and *Fownes'* 'Inorganic Chemistry' (last edition). Take the syllabus in your hand, and select what you want. For the analysis, you had better join a chemistry class. If you cannot, consult us on anything you cannot understand.

30. GARCON.—These are all published. You can get them through a bookseller, price 6d.; if you like better, write to South Kensington for them. The address is, The Secretary, Science and Art Department, South Kensington. 60.

31. ANONYMOUS.—Buy the editions previously named. 'Bacon' and the 'Paradise Lost' need much study. Be prepared to paraphrase any unusual expression. Give the meaning of any words now obsolete, or used in a different sense. In 'Milton,' the allusions should be understood. The context of important phrases and difficult constructions should be committed to memory; also passages illustrating the chief figures of speech.

Johnson's 'Lives of Pope and Dryden' does not need such detailed study. Strive to get a grasp of the subject as a whole, and remember the most important judgments which Johnson passes on the chief works of these poets, and how he illustrates and enforces his conclusions.

32. R. B.—'Acting teachers who have not passed with credit in the preceding year in either (or both) of groups (*c*) and (*d*) must take it (or them) up again.' How does this affect you? You can only take two groups beside English and school management, and if they are (*c*) and (*d*) you cannot take languages at all. If you can, then political economy will count as one language.

33. KAPPA.—For Trigonometry you can use the lessons now appearing in this magazine. The best books for beginners yet published are, in our opinion (1) *Lock's* 'Trigonometry for Beginners,' or (2) *Pinkerton's* 'Trigonometry.'

For Chemistry, you can use *Roscoe's* new edition of his 4s. 6d. manual, or *Dr. Aveling's* 'Chemistry,' J. Hughes, 4s. 6d., or post free, 3s. 6d., or *Fownes'* 'Inorganic Chemistry.'

34. J. R. AIREY.—(1) We cannot at present recommend a book on the 'educative work of Froebel.' (2) We hope the Lessons on Mental Science as applied to Education will exactly meet your requirements. They are expressly written for that purpose. Make them widely known.

35. E. P. J.—Not quite so many. Small-hand, 85; large-hand, 80.

36. BURRELL.—You will find *Macmillan's* 'Progressive Series,' I., II., and III., very good. Read the authors, and get your composition corrected by a competent person. You would receive full information respecting the tonic sol-fa by writing to 'Alpha,' care of Mus. Bac., 130, Horseferry Road, Westminster. *Curtis'* 'Grammar' is good; try it.

37. SHOT.—Let there be n spheres of radius r in a side of the square next the ground. We require to find the height of the centre of the highest sphere above that of the centre of the lowest. It will be seen from a figure that this is $(n-1)r\sqrt{3}$. A right-angled triangle with perpendicular height $(n-1)r\sqrt{3}$ and base $(n-1)r$ will have for hypothenuse a line parallel to the tangent of the slope of a face (from similar triangles).

$$\therefore \text{Tangent of angle of slope of face} = \frac{(n-1)r\sqrt{3}}{(n-1)r} = \sqrt{3}$$

$$\text{The tangent of the angle of the edge} = \frac{(n-1)r\sqrt{3}}{(n-1)r\sqrt{2}}$$

$$= \frac{\sqrt{3}}{\sqrt{2}} = \tfrac{1}{2}\sqrt{6}.$$

38. X. Y. Z.—The mass moved is $12\frac{1}{2}$ decigrams; the mass causing the motion is $\frac{1}{4}$ a decigram.

$$\therefore f = \frac{\frac{1}{4}}{12\frac{1}{2}}\text{ g.} = \tfrac{1}{50}\text{ g.}$$

Now $S = \frac{1}{2}$ ft.^{2} $= \frac{1}{2} \times \frac{1}{50} \times 9{\cdot}81 \times 25 = 4{\cdot}9$ metres.
The force having ceased to act after 5 seconds the body will move with constant velocity. Its velocity at the end of 5 seconds is given by the formula $V = ft.$, where $f = \frac{1}{50}$ g.

$\therefore v = \frac{1}{50} \times 9{\cdot}81 \times 5 = 1{\cdot}96$ metres per sec.
And the space passed over in two seconds $= 3{\cdot}92$ metres.
The answer $3\frac{17}{25}$ or $4{\cdot}704$ is wrong.

Arithmetic.

1. LEICESTERSHIRE.—Suppose a pack of cards be made into 7 heaps, so that the spots on the bottom card of each heap, added to the number of cards laid thereon, may make 12, and then there are 12 cards left; find the number of spots on the bottom cards.

No. of cards used $= 52 - 12$
" " $= 40$;
" " without the bottom cards
$= 40 - 7$
$= 33$;
$\therefore$ No. of spots on the bottom cards $+ 33$
$= 12 \times 7$
$= 84$,
$\therefore$ No. of spots on the bottom cards $= 84 - 33$
$= \underline{51}$. Ans.

2. TRY AGAIN.—Show that for a bicycle with a wheel of 50 inches diameter, the number of revolutions in 9 seconds is approximately the rate in miles per hour. Give the ratio of diameter to circumference :: 2 : 7. (*Lower Division*, May, 1882.)

Circumference of bicycle $= 50$ in. $\times \frac{7}{2}$
$= 175$ in.;

$\therefore$ No of revolutions in 9 seconds

$$= \frac{9}{60 \times 60}\left(\frac{\text{Rate per hour in miles} \times 63{,}360}{175\text{ in.}}\right)$$

$$= \frac{792}{\cancel{6336}\ \cancel{\times 175}\ 5}\text{ (Rate per hour in miles)}$$

$= \frac{792}{875}$ (Rate per hour in miles)

= Rate per hour in miles, approximately.

3. GENTIL.—How much pure gold must be added to $18\frac{4}{5}$ oz. of metal at $\frac{11}{12}$ fineness to raise the whole to $\frac{23}{24}$? (*Thrower.*)

Quantity of pure gold $(1 - \frac{23}{24})$
$= 18\frac{4}{5}$ oz. $\times (\frac{23}{24} - \frac{11}{12})$,

$\frac{1}{24}$ Quantity of pure gold $= 18\frac{4}{5}$ oz. $\times \frac{261 - 242}{264}$
$= 18\frac{4}{5}$ oz. $\times \frac{19}{264}$,

$\therefore$ Quantity of pure gold $= \left(\frac{\cancel{94}^{47}}{5} \times \frac{19}{\cancel{264}_{132}} \times \frac{\cancel{264}^{44}}{1}\right)$ oz.
$= \frac{893}{7}$ oz.
$= 119\frac{\cancel{6}^{3}}{7}$ oz.

= $119\frac{3}{7}$ oz. Ans.

4. MISTY.—During the first half of the present financial year the income tax was fixed at 5d. in the £, but during the second half it was increased to 8d. in the £. A gentleman whose income was at the rate of £1,000 a year more in the second than in the first half-year, finds that he pays for the year £35 8s. 4d. more income tax than he would have paid if the income tax had remained unchanged. Find income and income tax. (*Capel's 'Catch Questions.'*)

d. £ s. d. £
3 : 35 8 4 :: 1 : Income in second half-year.

20
708
12
3 | 8500
£2833 6s. 8d.

$\therefore$ Income = (£2833 6s. 8d. × 2) − £500
= £5166 13s. 4d. Ans.

$\therefore$ Income-tax = (2,333⅓ × 5) d. + (2,833⅓ × 8)d.
= (11,666⅔ + 22,666⅔)d.
= 34,333⅓d.
= 2861s. 1⅓d.
= £143 1s. 1⅓d. Ans.

Algebra.

1. CLEMENS.—Simplify :—

$$36\left(\frac{7a}{9} - \frac{5a}{4} + \frac{b}{12}\right) - 63\left(\frac{2b}{7} - \frac{5a}{9} - \frac{4}{21}\right).$$

$$36\left(\frac{7a}{9} - \frac{5a}{4} + \frac{b}{12}\right) - 63\left(\frac{2b}{7} - \frac{5a}{9} - \frac{4}{21}\right)$$
$= 28a - 45a + 3b - 18b + 35a + 12$
$= 28a + 35a - 45a + 3b - 18b + 12$
$= 18a - 15b + 12$
$= 3\ (6a - 5b + 4)$. Ans.

2. WITTON.—A party at a tavern, having to pay their reckoning, and being a third as many men again as women, agree that each man shall pay half as much again as each woman; but a man and a woman having gone off without paying their share—7s. 1d.—each man and woman remaining had to pay respectively 3d. and 2d. more. What was the reckoning? (*Colenso.*)

Let x = No. of women;

Then $\frac{4x}{3}$ = „ men;

$\therefore 3\left(\frac{4x}{3} - 1\right) + 2(x - 1) = 85$
$4x - 3 + 2x - 2 = 85$
$6x = 85 + 5$
$= 90$
$\therefore x = 15$.

$\therefore$ No. of women = 15;
„ men = ½ of 15 = 20.

A woman's share = $\frac{2}{2+3}$ of 7s. 1d.
= ⅖ of 7s. 1d.
= 2s. 10d.;

A man's share = 7s. 1d. − 2s. 10d.
= 4s. 3d.;
Amount for the men = 4s. 3d. × 20
= £4 5s.;
„ „ women = 2s. 10d. × 15
= £2 2s. 6d.;
$\therefore$ Reckoning = £4 5s. + £2 2s. 6d.
= £6 7s. 6d. Ans.

3. W. HEATH.—(*a*) Two persons get into an empty railway-carriage accommodating 6. In how many different ways can they seat themselves?

(*b*) In how many different ways can a first and second prize be given among 10 boys (no boy to hold both)? (*Pupil Teachers' Examination.*)

(*a*) No. of ways = 6.5
= 30. Ans.

(*b*) No. of ways = 10.9
= 90. Ans.

4. JENISA.—Show that if $x^4 + ax^3 + bx^2 + cx + d$ be a perfect square, the coefficients satisfy the relations
$8c = a(4b - a^2)$ and $(4b - a^2)^2 = 64d$. (*Todhunter.*)

If $x^4 + ax^3 + bx^2 + cx + d$ be a perfect square, the square root must be of the form $x^2 + px + q$, where p and q do not contain x.

Thus we must have *identically*
$x^4 + ax^3 + bx^2 + cx + d = (x^2 + px + q)^2$
$= x^4 + 2px^3 + (p^2 + 2q)x^2 + 2pqx + q^2$;

Thus, $a = 2p$
$b = p^2 + 2q$
$c = 2pq$
$d = q^2$

$\therefore a(4b - a^2) = 2p\{4(p^2 + 2q) - (2p)^2\}$
$= 2p(4p^2 + 8q - 4p^2)$
$= 2p \times 8q$
$= 16pq$
$= 8c$.

$(4b - a^2)^2 = (8q)^2$
$= 64q^2$
$= 64d$.

5. LAVINGTONIAN.—In how many years will a sum of money treble itself at 5 per cent. compound interest? (*Hamblin Smith.*)

Let P denote the principal, and n the number of years;

Then, $P\left(1 + \frac{5}{100}\right)^n = 3P$,
$(1{\cdot}05)^n = 3$,
$n \log (1{\cdot}05) = \log 3$,
$n = \frac{\log 3}{\log 1{\cdot}05}$
$= \frac{{\cdot}4771213}{{\cdot}0211893}$
$= {\cdot}0211893)4771213(22{\cdot}5$
423786
533353
423786
1095670
1059465
36205

$\therefore$ Time = 22·5...years. Ans.

6. FFRWD.—

If $\frac{a+b}{b} = \frac{b+c}{c} = \frac{c+a}{a}$, prove that $a = b = c$.

If $\frac{a+b}{b} = \frac{b+c}{c} = \frac{c+a}{a}$,

$\frac{a}{b} + 1 = \frac{b}{c} + 1 = \frac{c}{a} + 1$,

$\therefore \frac{a}{b} = \frac{b}{c} = \frac{c}{a}$

If $\frac{a}{b} = \frac{b}{c}$, then $ac = b^2$,

$\frac{b}{a} = \frac{c}{a}$, then $a^2 = bc$;

$$\therefore \quad ac \times a^2 = b^2 \times bc$$
$$a^3c = b^3c$$
$$a^3 = b^3$$
$$\therefore \quad a = b.$$

If $a^2 = bc$
$a^2 = ac$
$\therefore \quad a = c.$

$\therefore \quad a = b = c.$

7. W. H. ACUM.—A person deposits £2,500 at 4 per cent. per annum compound interest; for how many years can he withdraw £150 on the anniversary of the deposit? When he has drawn the last £150, what sum will be due to him as a final repayment at the next anniversary? (*Science and Art*, May, 1884.)

Let P denote the amount on the first anniversary, R the amount of one pound in one year, n the number of years, and A the annual withdrawal;

Then, $PR^n = \frac{R^n - 1}{R - 1} A$;

$$2600\,(1{\cdot}04)^n = \frac{(1{\cdot}04)^n - 1}{1{\cdot}04 - 1} \times 150$$
$$= (1{\cdot}04)^n - 1 \times \frac{150}{{\cdot}04}$$
$$= \{(1{\cdot}04)^n - 1\} \times 3750,$$
$$\tfrac{2600}{3750}\,(1{\cdot}04)^n = (1{\cdot}04)^n - 1,$$
$$(1{\cdot}04)^n - \tfrac{26}{37}\,(1{\cdot}04)^n = 1,$$
$$\tfrac{11}{37}\,(1{\cdot}04)^n = 1,$$
$$(1{\cdot}04)^n = \tfrac{37}{11},$$
$$n \log 1{\cdot}04 = \log 75 - \log 23,$$
$$\therefore \quad n = \frac{\log 75 - \log 23}{\log 1{\cdot}04}$$
$$= \frac{1{\cdot}8750613 - 1{\cdot}3617278}{{\cdot}0170333}$$
$$= \frac{{\cdot}5133335}{{\cdot}0170333}$$
$$= {\cdot}0170333)\overline{{\cdot}5133335}(30$$
$$\underline{510999}$$
$$\underline{23345}$$

$\therefore$ No. of years = 30. Ans.

Amount left = $\frac{23345}{170333}$ of £150
= 23345
150
170333)3501750(£20
340666
95090
20
1901800(11s.
170333
198470
170333
28137
12
337644(1d.
170333
167311

= £20 11s. 2d. Ans.

8. HANNIBAL.—Two clocks are striking the hour together, and are heard to strike 19 times. There is a difference of two seconds in their time, and one strikes every three, the other every four seconds. What is the hour they strike, it being observed that, when the clocks strike in the same second, the sounds cannot be distinguished, so as to determine whether one or both strike in that second, and that is the case with the last stroke of the faster clock? (*Wood's* 'Algebra,' by *Lund.*)

As 19 strokes are heard, the time is 10, 11, or 12 o'clock.

The last stroke of the first clock coincides with one of the strokes of the second clock.

(Time − 1) × 3 = An even number,
$\therefore$ Time = An odd number;
$\therefore$ Time = 11 o'clock. Ans.

The Nääs Slöjd.

BY MISS J. WARREN,

Inspectress of Infant Schools to the Leicester Board.

(*Continued from page* 21.)

My last three papers have been devoted to the foundation principles of the Slöjd and the eighteen rules upon which the set of models is founded from which the children work.

A sheet showing these articles and a short description of the size and use of each will be given shortly; but, owing to the bad weather, this has for the present to be put on one side.

I purpose devoting this article to a consideration of the main reasons for *wood* being employed at Nääs, and also to open up the question that we had so clearly demonstrated to us while there, viz., whether it would not be better, in the interests of the children, during their education in manual labour, to have to work in more than one material?

To begin with the latter consideration—

Shall we have one or more than one Slöjd subject?

The sound basis upon which we are founding our Slöjd teaching must now come into play. We have said elsewhere that Slöjd is not merely manual work, but a means to give to our Elementary Schools a sound formative education. This grand purpose must be before our eyes continually, and no consideration, as to the future calling in life of our children, must for a moment stand before it. It is not enough for our purpose that we can prove the mere utility of the work suggested; the true meaning of the word 'elementary' must be realized. We have to do with elements, and these in a limited number. Endless Slöjd subjects might, with some amount of success, be dabbled in, but each one of these would tend to rob the other of some perfection. One of the great banes of the present-day education is that too much is attempted to admit of satisfactory results in necessary subjects. If, therefore, it is a fault to multiply subjects in merely intellectual studies, it is doubly so when the hand and brain are in the balance. There are other and still more cogent reasons.

First. We are limited as to time. In our school-time we are unable to devote more than five or six hours weekly to Slöjd. In some few schools in Sweden more is given, but in by far the greater number the Slöjd class meets twice a week, and then only for two hours' work. When one realizes the age of the children (beginning at about ten years) and the vast amount of manipulative practice they will necessarily require, it will be easily conceived that, if *one material answers our purpose*, it would, indeed, be a short-sighted policy to have more.

Secondly. The Slöjd, to be taught as in Nääs, must be in the hands of the ordinary elementary teacher. (I shall have more to say on this before I have done.) He has very little time at his command for his own studies, and to require more of him than a thorough knowledge of one Slöjd subject would be obviously unfair when we reflect that, together with the skill of a craftsman, he must combine the power of a teacher in no meagre degree.

I may say, *en passant*, that the teachers of the normal schools, both in Sweden and in other countries, whom we met all seemed, like ourselves, to be in a chronic state of hurry, always having just one

more straw than could be conveniently carried—just one more subject in their schools than they would have taught had the framing of the Code been left to their superior wisdom. We occasionally chewed the cud of our united wrongs as teachers, and made frantic efforts to prove that no 'My Lords' were quite so short-sighted as those of our special country, but, being limited in language, these little sallies died out in the end in silence. But enough of this.

Thirdly. The interest and force of the child must not be divided. His capacity is not boundless, and it is of the utmost importance that the whole physical and mental power shall be brought to bear upon the Slöjd in hand. By the introduction of several Slöjds, many of our most important rules would be violated.

These reasons are, of course, purely educational, but we may also add that of *economy*. The cost of many materials would, indeed, be a serious drawback. We shall now sum it all up by asking, Can the education we have planned out (*vide* Rules, Principles, etc.) be carried on by Slöjd in one material? If not—mark you—*more than one must be introduced;* for we are, I hope, convinced that a Slöjd we must have, at any cost.

It will not do to hurry over this part of the subject, for upon it hinges very important issues to us as teachers. It is more easy to jump to a conclusion than to go through the train of thought by which we reach it. It is only after years of thought, adjustment, experiment, and study, that our friends at Nääs have decided to adopt *wood* for their Slöjd material; and, not to lead my readers astray, I must add here that Herr Saloman has, by invitation, visited nearly every Slöjd or technical school on the Continent, and been appointed on their councils as judge or referee. His knowledge is wide and varied. When we add to this that to his own Slöjd Seminarium come people from all parts of the world to learn the system, we shall not, I think, treat lightly the fact that he places *wood* before all other material.

The table accompanying this article will, perhaps, put the matter better before the teacher than any words of mine can do. It is a copy of one given to all of us who studied and worked out the course, and the Slöjd subjects are all of them known in different parts of the Continent. Others might have been given, too; but these, I think, are sufficient for our purpose.

With such a convincing proof of the efficacy of wood, and its apparent superiority over other materials, we may, as learners, rest content for the time. Wood is cheap, too, both in Sweden and in England. Some will, as many have done, take objection to this last remark; but, compared with its usefulness, it is cheap.

Now, to go back to the subject of the teacher. I want to be quite understood at the onset, because my remarks are necessarily discursive here. *In the Nääs Slöjd the elementary teacher only conducts the Slöjd class; no special teacher is allowed.*

Why? Wouldn't a teacher devoting his whole time to it be far more likely to do the work better? This might be, but who amongst us has not suffered from the craze of a specialist—kindergarten, needle-work, or indeed any craze? What, may I ask, is the effect upon the broth (brains) of too many cooks (teachers)? Let each one of us ask ourselves to seriously, is it well for the child to have so many teachers working on its living organism?—doesn't each one pursue his subject, entirely forgetting all others in his zeal for the one? Much of the overpressure, in my opinion, is due to this system of specialists. I am aware that I am now considering the child only; but, then, we *must* consider the child when such a case occurs. Many people urge the special-teacher scheme, but if education is the perfect development of the child's whole being, and not the forced growth of one part to the detriment of another, then the many-teacher scheme dies out. It is, indeed, a sort of race in which the child is entirely forgotten. Who ever heard of a music-teacher giving half-an-hour's practice less, because, forsooth, there is a French master's theme to prepare? I fear I must leave this discussion open until next month, when I hope to go into the question:—'Who shall teach the Slöjd?'

TABLE SHOWING, BY MEANS OF THE RULES, WHY WOOD IS CHOSEN IN OUR SLÖJD INSTEAD OF ANY OTHER MATERIAL.

Question.—Are the following conditions satisfactorily complied with?

SUBJECT.	Does it engage the attention of children?	Is there a practical application of models?	Does it give general dexterity?	Order and Exactness?	In accordance with physical force of child?	Esthetically educate the child?	Build and develop its physical nature?	Cleanliness and neatness?	Counteract the sedentary habits?	In accordance with a methodical exposition?
Smith-work ...	Yes & No	Tolerable	No	No	No	No	No	No	Yes	Perhaps
Metals	Yes & No	Yes, No	Yes	Yes	Yes, No	No	Yes	No	Yes	Yes
Basket-making ...	No	Tolerable	No	No	No	No	No	Yes	No	No
Painting	No	No	No	No	No	No	No	No	Yes	No
Fretwork	No	No	No	Yes	No	Yes	No	Yes	No	Yes
Bookbinding	No	No	No	Yes	No	No	No	Yes	No	No
Pasteboard	Yes?	Yes	No	Yes	Yes	Yes	No	Yes	No	Yes
Slöjd Carpentry ...	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Turnery	Yes	Yes	No	Yes, No	Yes, No	Yes	Somewhat	Yes	Yes	Yes
Sculpture	Yes	Yes, No	No	Yes	Yes	Yes	No	Yes	No	Yes

How to Earn the 'Excellent' Grant.

By One of Her Majesty's Inspectors of Schools.

Before a school can be taught excellently it is perfectly clear that regular attendance must have been secured from the scholars, and that they must have been reduced to absolute discipline. If the educational authority does its duty, the attendance will be good, independently of any special exertion on the part of the teacher. If, on the other hand, as is only too frequently the case, the Local Authority is shy of using its compulsory powers, or is discouraged from putting them forth by the antagonistic attitude of the magistrates, good attendance will greatly depend upon the managers' and teachers' powers of persuasion and attraction. Some managers, and notably Roman Catholic priests, possess the power of actively or indirectly persuading children to school. I have known a worthy cleric of the Roman Church use a stick with the most startlingly salutary effects; and I have known clergy of the Church of England, by a persistent course of visiting at the parents' homes, successful in creating good attendance.

But such voluntary-attendance officers are *raræ aves*. Most teachers, therefore, are thrown upon their own resources to secure good attendance; and manifold are the devices which they pursue to make their scholars regular. The personal popularity of the teacher goes a long way, but unless that popularity is coupled with an attractive method of teaching, a high percentage of attendance cannot fairly be expected.

So far, the influences named will be accepted as legitimate by all. Now come methods for improving attendance, which fall under the heads of rewards and punishments and extra-official work on the part of the teacher. Let us first deal with the question of rewards and punishments.

Many persistently refuse to admit the principle of rewards for school attendance. This attendance, they say, is compulsory, or supposed to be so. To reward children for attending school regularly is an absurd anomaly. Indeed, the Department goes so far as not to permit School Boards to give money prizes for school attendance, or to lessen or remit fees in consequence of it. To this we reply that attendance prizes are authorised to be given by Boards, provided they do not take the shape of money rewards; while voluntary managers have perfect liberty to remit or return a portion of the fee for good attendance, or to give money prizes, provided such prizes be not charged in the school accounts. Again, voluntary managers can punish irregular scholars by making them pay a higher fee, even although it may amount to a prohibitory one. Rewards, if given with discrimination, have undoubtedly a vast effect on school attendance, and we strongly urge the weekly-ticket system as the best of the attendance prize plans. Under this system a card is given to every scholar who has made the total number of attendances possible in the week. The register should be marked within five minutes of assembling, and the children present credited with a mark for early attendance; others coming in before the registers are finally closed receive a qualifying mark for Government purposes, but are regarded, to a certain extent, as defaulters. A child who has been present at the ten openings of school, and has remained for the whole of each school meeting, becomes entitled to a weekly ticket. Under exceptional circumstances, such as severe weather, long distances delicate health, nine, or even eight, attendances might qualify for a ticket. Each weekly ticket has a distinct value, say a farthing, for infant and First and Second Standard children; a halfpenny for a child in the higher standards. Not that a money prize is contemplated, but these tickets count as so many farthings or halfpennies on the way to a book-prize, or a toy, or a garment.

But why should the tickets be weekly? For two very good reasons. First, children's memories are short and their efforts are fitful, and they are easily discouraged, and if you tell them, therefore, that they shall have a ticket at the end of a month, or three months, if they make a certain number of attendances, it is only the child of rare purpose that will make the continuous effort necessary to secure the reward.

But for a *weekly* ticket children will make a push, and if they miss it by one mark one week, they will struggle in competition with one another to secure it the next. This has been proved to demonstration. Another argument in favour of the weekly ticket is, that if a truant or irregular child begins to see the errors of his ways, he has a chance of making amends, through the weekly ticket, at any time during the year.

More important still, new scholars, many of whom are inclined to attend school irregularly at the outset, for one cause or another, have this stimulus before them, no matter what time of the year they join the school. Upon the tickets are recorded the names of the scholars and the date of the award. In some schools quarterly prizes are given for a certain number of these tickets; in others, half-yearly ones; and we are inclined to favour such prizes in preference to yearly rewards. For the visible result thus gained at the end of a shorter period gives a fresh fillip to a child's regularity, and is, therefore, preferable to a prize looked forward to for a whole year. In addition to this prize system, many teachers use absentee-forms, which they send to parents in cases of the non-appearance of their children without a written explanation. Others use weekly home cards containing marks for attendance, conduct, and lessons during the week, which are taken home at the end of it by the scholars, and brought back by them with the parent's signature on the following Monday.

Not a few teachers also beat up the parish themselves, and recommend themselves by good offices to the parents, to such a degree that they are much more willing to send their children regularly to school. Indeed, we know not a few instances where the village schoolmaster is the recognised factotum, going even the length of making all the old people's wills.

Granted, then, we have obtained good attendance—say 85 per cent. of the attendance possible—we are on the high road to the 'Excellent' merit grant.

Now comes the question of organisation.

If, immediately the Government examination was over, the teacher would take pains to scheme out a new year's work, in quarterly, or even half-yearly divisions, and resolutely carry out the course thus indicated from week to week and month to month, it would speedily be found that no necessity existed for keeping the whole school in after hours. Our experience of three districts convinces us that the whole year's work can be got through in nine months, and that three months should amply suffice for the revision and perfection of it.

The advantage of this system is, that the scholars

who have joined the school in the course of the year will, at any rate, have the advantage of going through the entire course towards the end of it. With such scholars inspectors are inclined to deal leniently. If they have been twenty-two weeks on the books, but have been irregular through illness or any other reasonable cause, they are often exempted from examination.

And here, while we distinctly disclaim any desire to interfere with recognised methods of organisation and instruction, we may state what methods have struck us as especially worthy of acceptance.

The organisation of a school will much depend upon the faithful carrying through of a good time-table.

The time-table should, of course, allow for a sufficient amount of time per week in each of the subjects taught in all the classes, and would gain by containing a summary showing that time. It *must* now have set forth upon it a scheme of the pupil teacher's lessons, and should also give a routine of the home lessons of the scholars.

Subjects requiring a clear head, such as arithmetic, grammar, and much of geography, should be taught early in the day; and mechanical and recreative lessons, such as writing, singing, and drawing, taken last in the afternoon.

The head-teacher should arrange so that his class may be doing work which does not require his constant presence during the important lessons in other classes which need his supervision.

It speaks ill for the organising powers of a teacher when he alters his time-table in prospect of some diocesan, drawing, or Government examination, instead of making out a good time-table, and sticking steadily to it. Alternative subjects on a time-table are objectionable on the same ground, tending, as they do, to irregularity of work. Far better, instead of saying 'Reading *or* Geography,' to devote one lesson to reading, and another to geography, at fixed times.

If the above precautions are taken in methodising the work of a school, a strong foothold in dealing with the New Code will have been secured by the teacher. Now comes the question of teaching the different subjects under the Code with success. Let us begin with *Reading*.

(To be continued.)

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The 'Practical Teacher' Prize Competition for Pupil Teachers.

JUDGE—C. J. DAWSON, ESQ., B.A.,
Ex-President of the National Union of Elementary Teachers.

HAVING completed the somewhat difficult task of examining the numerous papers sent in by Pupil-teachers from various parts of the country, and deciding on the best, we have pleasure in presenting our award.

The following are the names of the successful competitors :—

FEMALES.

1st Year.—'Snowdrop.' Annie Cook, Barton Manor School, Ampthill.
2nd Year.—'Little Dorrit.' Caroline M. Holoran, Osmaston Road, Derby.
3rd Year.—'Helena.' Grace Hague, Wesleyan School, Staleybridge.
4th Year.—'Cecilia.' Martha Cecilia Jones, Glandwr Board Schools, Llanidloes, Montgomery.

MALES.

1st Year.—'Mercara.' (Address lost. Please forward it.)
2nd Year.—'Jimmy.' James L. Mills, Glandwr Board Schools, Llanidloes, Montgomery.
3rd Year.—'Gyp.' Edwin Geo. Lynex, National School, Kirkham, Lancashire.
4th Year.—'Barum.' Alfred L. Cann, Union Street, Barnstaple.

Papers bearing the following pseudonyms are worthy of special commendation as coming near to taking a prize :—'Van,' 'Espérance,' 'Nullum Nomen,' and 'Hope,' in 1st Year. 'Philomel,' 'Devonian,' 'Endeavour,' and 'Violet,' in the 2nd Year. 'Competitor,' and 'Selina,' in the 3rd; and 'St. Peter's,' and 'Snow,' in the 4th.

Cheques for the amount of the prizes will be forwarded before the 12th instant. To those who have tried their best and have neither prize nor special praise, we would still offer words of encouragement, and express the hope that the practice of answering our questions may help them to attain success in their government examinations.

In future numbers of the PRACTICAL TEACHER, we shall endeavour to give such hints as are suggested by careful examination of the answers sent in. Pressure of space obliges us to content ourselves now with urging the importance of reading with close attention the instructions printed on the examination papers, and also the questions. No advantage is gained by giving information which is not asked for, nor by answering more questions than are permitted.

In our next issue we shall print the answers of the successful candidates.

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Publications Reviewed.

Cassell's Modern School Series. Shakspere's Plays: Julius Cæsar. Coriolanus. London: Cassell and Company, Limited.

We have here two samples of a series of Shakspere's plays, edited specially for elementary schools. In each book, a brief but well-written sketch of the life of Shakspere, and a short historical introduction, are prefixed to the play. By considerable omissions, the text is reduced in each case to little more than the 1,500 lines which will satisfy the special requirements of the Education Department, as far as dramatic reading for the upper standards is concerned. We observe that, as an aid to expressive reading, emphasis is indicated in many places by the rather unusual plan of placing the grave accent over the emphasized word, thus :—

'My mòther,
Who has a chàrter to extol her blood,
When she does praise me grieves me.'

This method, however, is not used with uniformity, for whole pages are passed without any indication of emphasis; indeed, it appears to be used chiefly in cases where the need for emphasis is most obvious. Abundant notes, of a simple explanatory and grammatical character, are placed at the end of each play. These are probably much more suitable for the class of pupils they are intended for than the scholarly, etymological, and critical notes with which some school editions of Shakspere are rather overloaded.

The Civil Service Calendar, 1886. Edited by William Bussell. London: W. Stewart and Co.

To the many students who intend to compete for posts in the Civil Service this book will prove very useful. It contains the official regulations under which admission to Government offices is obtained, numerous specimens of the various examinations to be passed in the different grades of the service, instructions for candidates, and model answers and solutions to some of the papers given.

While the work is specially valuable for Civil Service candidates, we believe the hints and suggestions it contains may be of much use also to teachers generally, and to students preparing for other examinations than those for Government offices. Indeed, the requirements of the Civil Service Commissioners seem to us to be, in many respects, of such a practical and sensible character, that they might well guide the aims of most teachers whose pupils are likely to enter upon a business career, so far, that is, as the particular conditions of their school-work will allow. For example, no arithmetical ability is more essential in business than that acquired by abundant practice in what are technically known as 'long tots' and 'cross tots.' For

children in elementary schools, exercises in long additions and in other formal questions, with a view to ensure speed and accuracy in calculation, are likely to prove a better practical preparation for the work of many of them on leaving school than the ability to unravel arithmetical riddles. Again, it has often occurred to us that readiness in reading manuscript is almost as important for clerks and others engaged in business as ability to read from printed books. The Civil Service Commissioners take care to test this ability, even in the case of boy clerks, by exercises in deciphering and copying manuscripts, which are often of a rather puzzling character. Another good means of testing handwriting is applied—namely, the copying of a tabular statement. On the general character of handwriting, the following quotation from a report of the Commissioners deserves attention: 'We have observed upon the importance which we attach to good handwriting as one of the most useful accomplishments which a clerk can possess, and one which any young man has it in his power to acquire. In consequence, probably, of the insufficient attention paid to the subject in schools, the quantity of bad handwriting which comes before us is still very great. What we require is the clear formation of the letters of the alphabet. We do not demand or desire that the writing should be of any particular style, provided that it possesses the main characteristic of legibility.' Lithographed specimens of approved handwriting, and of the tests in deciphering manuscripts, are inserted in the calendar, which also contains many exercises in dictation, in orthography, in the difficult form of passages badly spelt to be corrected, and in English composition. All the subjects we have referred to are of capital importance, and are required in the lower ranks of the service. In the examinations for the higher offices we have exercises in indexing, summarising returns, précis-writing, and book-keeping, as well as in geography, history, language, literature, and mathematics. All these requirements are amply illustrated in the book before us.

Digest of Returns and Tabular Statements. By William Bussell. London: Stewart and Co.

Indexing and Precis-Writing. By William Bussell. London: Stewart and Co.

In the first of these two volumes, which belong to a series of Civil Service text-books just published by Stewart and Co., we find a dozen exercises in digesting returns into summaries, selected from the papers set, up to January 1885, to candidates for men clerkships. These are prefaced by a short introduction, explaining the manner in which the exercises should be worked, and followed by a dozen examples of tabular statements to be copied.

The second book is larger, and contains a number of specimen papers which have been set in recent years in examinations for men clerkships and higher offices. Each paper consists of a series of letters on some particular subject, and the first of these papers, including twenty-eight letters between Her Majesty's Government and the Governments of Peru and Chili, is fully worked out as a model of what is required. The introduction contains useful explanations and directions. Both books are well printed and well edited, and appear to be well-adapted for the assistance of Civil Service candidates.

Blackie's Drawing Series. Demonstration Sheets, Sets I., II., IV., V.: Drawing Copies, Scholars' and Teachers' Slate Cards. London: Blackie and Son, 49 and 50, Old Bailey.

The requirements from elementary schools are already beyond the capacity of many of our children, and it would be greatly to the advantage of not a few if the subjects were limited in number. Notwithstanding this plethora of subjects, there exists a desire to introduce technical education into these schools. From a long practical acquaintance with their working, we are decidedly of opinion that to do so, while schools are conducted under present conditions, is impracticable, and if persisted in would be injurious to their best interests. If the requirements in some other subjects were modified, however, it would be to the advantage of our future skilled artisans and workmen were the elements of drawing, a good knowledge of which lies at the foundation of all true technical education, taught more systematically in our schools. Holding this opinion, we are not among those who object to the New Drawing Schedule, evidencing, as it does, a desire to popularise and systematise our instruction in drawing. We hope, however, that such modifications may be made in future codes as will render it more practicable, especially in those schools where the subject is taken up for the first time.

Messrs. Blackie and Son have in their Drawing Series for the Standards anticipated the demand which will be made for the carrying out of the requirements in this new class subject. Their Drawing Copies are issued in small books instead of on cards, and for the four numbers already issued—two for Standards I. and II., and two for Standard III.—we have nothing but praise. Commencing with straight lines, to be copied, in the First Standard, on a properly prepared slate-card, and, in the Second Standard, in a similarly geometrically-ruled book, progress is made by easy stages to angles, triangles, squares, and other simple geometrical forms, freehand examples of right-lined common objects being freely interspersed in the later book among the examples for pencil and ruler. Curved lines are introduced in the first book of Standard III., and the examples are of an easy progressive character till curved line common objects are reached. Many of the simple geometrical designs in the second book are very effective. Issued with the books are sets of Demonstration Sheets, which correspond exactly with the copies, except in size, the dimensions being three times that of the books. They are very effective, and can be clearly seen at a great distance. Considerable time and labour will be saved by their use. To render teaching still easier, a slate-card, 24″ × 18″, has been prepared, at a very reasonable price, for the teacher's use; and as it would be inconvenient and costly to have ordinary slates ruled in the required way for Standard I., a small slate-card is also used for the children of this stage. We shall await with some expectation the appearance of the other numbers of the series; but if the promise of these earlier portions is fulfilled, the publishers may congratulate themselves upon having supplied a decidedly useful, acceptable, and excellent Drawing Series.

Century Cards: English History. London: W. Swan Sonnenschein and Co., Paternoster Square.

The Century Cards partake more of the nature of a game than of a serious study; in fact, the pamphlet accompanying them says that the system does not profess to teach history. Under present conditions, the Century Cards can find no place in elementary schools; but where history is seriously taught at home or in private schools—in fact, anywhere where two to a dozen boys and girls can be got together—we can conceive that they might be made of considerable service.

The objects aimed at are good, being—(1) to fix the approximate date of important events and persons firmly in children's minds; (2) to give them a clearer idea how far such events and persons were contemporaneous than can be easily gained by learning lists of dates; (3) to keep all the English history they have learned from 1000 A.D. quite fresh in their memories. To secure these objects the Century Card game provides—(*a*) a box of twenty-five packets, each containing twenty small tickets, with a printed name or event and a date, *without the century*, on each; (*b*) one or more cards (at the purchaser's option, according to the number of players expected), with nine differently-coloured squares for the nine centuries; (*c*) a couple of bags, one red and the other white. The players being each provided with a coloured card, dip their hands successively into one of the bags containing the tickets of one, two, or more centuries, according to the extent of their reading, and

arrange the tickets on their coloured cards in the proper century spaces and in chronological order. The longer the period of history studied, the more difficult it will be to remember the century to which each date belongs. When the cards have been withdrawn, the teacher, provided with the book of dates corresponding with the packets, is able to correct each child's work. All cards properly placed are transferred to the white bag, while all incorrectly placed are restored to the red bag, to be drawn at the next lesson. Should the tickets be too numerous for selection at one lesson, a portion only may be withdrawn, according to the length of time at disposal. The tickets having all been used, the process may be repeated till all the dates are known, when the cards may be put away for use with other pupils. An ingenious teacher may combine verbal instruction with the card selection, or oral questions may be put, or descriptions of persons or events required as the pupil places a card. In this way considerable benefit, besides the strengthening of memory, may be derived by all engaged in the game. Although this is given as the prescribed use of the cards, pupils will soon find other methods of using them, such as selecting ten persons or ten events first, or ten battles, or ten statesmen, and so on.

The coloured spaces could also be used for other cards, as ancient history, the preparation of these new tickets being the work of the children themselves.

Teachers may suppose that the method is cumbrous; but we believe that it is much more useful, and, in the hands of a skilful leader, may be made quite as interesting as many of the card games at present used for amusement. It is carrying Kindergarten methods a little further than the infant school.

Hints on the Study of English. By F. J. Rowe, M.A., and W. T. Webb, M.A. Calcutta: Thacker and Spink. (New edition, revised and enlarged.)

The 'hints' contained in this book are very numerous indeed, and appear to have met with much appreciation, as the sale of the work has reached forty thousand copies. Perhaps a better title would have been that of a Thesaurus, or Treasure-house of Information respecting the English Tongue. The book appears to have been written for the use of native students in India, and the laudable object of aiding the perplexed 'foreigner' has been kept well in view. Many of the mistakes against which the student is warned are such as would hardly have been made by the youth of Old England.

The work opens with a good historical sketch of the English language, which occupies fourteen pages. The lists of words are very copious here, as they are throughout the book. After this follows a chapter on the derivation and composition of words, and after that there is introduced a good deal of the information which we meet with in Trench's well-known 'Study of Words' and 'English, Past and Present.' The 'Parts of Speech' are then dealt with in the usual order; accidence and syntax, however, being thrown together without much orderliness of arrangement. After this follow about fifty closely-printed pages on 'Idiom,' which the Hindoo will find, we hope, quite a mine of information with regard to particular English phrases and uses. Hints on composition and style, and directions for letter-writing, essay-writing, and behaviour during examination next engage the reader's attention; after which follows a large collection of what are classed as 'Common Errors,' each of which is refuted by an appropriate rule of grammar, either quoted or framed for the occasion, and the book concludes with some copious appendices.

We notice some rather amusing peculiarities. The 'Examples' are largely pervaded with references to a certain Ram, who occupies here the same position as Balbus in the grammars of the late Dr. T. K. Arnold. Thus: (p. 209) 'Ram was above Sham in the class.' This, perhaps, justifies the assumption of superiority shown in 'Ram said to him (Sham), "You are wrong."' On another page we read, 'Ram beat the dog,' and 'Ram loves his mother.' Happily, this is not the other way. However, we were pained by reading, 'It was Ram that broke the window,' and 'I saw Ram up a tree.' The teacher is most likely recording his own deed in the words, 'I struck Ram' (having first got the delinquent into his power by a treacherous 'Come hither, Ram'). A subsequent concession to the beaten one's injured feelings appears in 'I gave Ram a book.' 'Ram jumps' is possibly a reminiscence of the flogging, and 'Ram rejoices,' of the subsequent gift. Later on, Ram is found in possession of a pony; perhaps, a reward of distinction, for we read (p. 204) 'Ram, the head boy of the class.' But we must refrain from writing Ram's history.

There is much valuable matter in this book. Most of the explanations are lucid, and some are original. Nothing can be better, *e.g*, than the author's remarks on the infinitives, the participles, and the verbal nouns. The chapter on 'Homonyms' (portentous word!) is a valuable one. Very useful, too, is the list of 'Disguised Words,' and of words followed by particular prepositions, as also the elaborate summary, which occupies twenty-two pages, of the uses of each preposition. The chapter on 'Indirect Narration' treats the subject with great clearness, and there is a good deal to be learned from the 'Notes on Spelling.' The whole work is commendably free from errors of printing and from misquotation, but did Gray really write 'the pipe's shrill clarion' (we always thought it was the cock's) in his immortal Elegy?

With the difficulties of the Indian student it is impossible not to sympathise. He is nothing if not logical, and a consideration of the errors into which he falls from sheer cleverness and consistency may give us a clearer insight into the glorious inconsistency of the English language. Truly, it must appear to him sometimes as though its ways were 'past finding out.' When the pupil has mastered the expression 'short of money,' he very naturally speaks of a rude individual as being 'short of politeness'; but, to his surprise, he is told that he must say, not 'short of,' but 'deficient in,' that very pleasing characteristic. A kind-hearted lecturer, who has been addressed with 'Sir, you are leaving back your pen,' must feel sorry to have to inform the friendly pupil that he must say, 'You are leaving your pen behind.' And, really, there is a wonderful amount of 'method' in the mind which lapses into nothing worse than such mistakes as the following:—

(*a*) 'I care a straw for the loss' (Lat. *flocci facio*).
(*b*) 'A good king is *as if* the father of his people' (Lat. *quasi*).
(*c*) '*As* I am ill, *so* I hope you will grant me leave' (*ut .....ita*).
(*d*) 'I shall leave my horses *near* him during my absence.'
(*e*) 'I have been ill since two months' (Fr. *depuis*).
(*f*) 'This is *so much a better* plan' (Lat. *tanto melius*).
(*g*) 'I have not yet *taken* my dinner' (But 'what will you *take*?').

These are certainly the mistakes of a student who is anything but a fool, and the appreciation of a well-known idiom which produced (*h*) 'I will see you *at yours* to-morrow' is really very creditable in a disciple.

India, however, is just the country where linguistic ability might be expected, for Sanscrit, we imagine, was studied scientifically long before any European language. We are all the more surprised at noticing one or two remarkable eccentricities among the 'Common Errors.' Can it really be necessary to warn the same students not to write 'The ship was drowned,' or 'I was ill to-morrow, but am better to-day'? It is amusing to notice a solemn caution to the student who is writing a letter, not to address his respectable friend as 'Dear Jones, Esq.,' or 'Dear Honble. Jones, C.S.I.'! A few of these touches do much to enliven the monotony of a grammatical treatise.

We admire the choice of examples from Tennyson, though possibly the poet (now, alas! the noble lord) may never have intended that his writings should point the

moral of English syntax for the mild Hindoo. Moreover, the absence of pedantry is a marked feature of this publication. A teacher must have shaken off a good deal of his stiffness before he can give his pupils, as an illustration of a rule in grammar, the words, 'And so say all of us' (!)

To conclude these observations:—We have in this recent addition to the host of works on grammar a book that, without being particularly well adapted for a class-book, is well worthy of a place on the shelf of a practical teacher. On a few points the possessor is pretty certain to see his way clearer, and a study of its pages will enable a teacher to vary his examples and, occasionally, his methods also. More than that can scarcely be expected of a work on such a subject.

Beginnings in Book-keeping. By Rev. J. Hunter, M.A. London: Longmans and Co.

This book is designed as an introduction and illustrating companion to the author's 'Self-instruction in Book-keeping'; but considering that it is intended for commercial schools, we presume the author does not intend it to be generally used without an instructor, though, as we have said below, we believe it might be. The preface, too, tells us that a key to the exercises is published. We cannot help, however, thinking that certain results of the exercises might be published, in the form of answers, at the end of the volume. This little volume of seventy-eight pages is divided into six chapters, at the end of each of which there are exercises illustrating the principles taught therein.

The first chapter gives a clear idea of the meaning of the word 'capital,' and we were particularly struck with the fact that the exercises worked out as well as those for practice were nearly all different, one exercise asking for the capital, another for the amounts for cash and goods, etc.

The different books used in the science are gradually introduced, the author bringing all his well-known teaching powers to bear.

We can well believe that any intelligent teacher, even though he brought very little knowledge of the subject to begin with, with this book would be able to give a class a very fair idea of the rudiments of the subject.

The book concludes with a simple and easy method of single entry, which is necessarily much used in certain businesses.

We cannot help fancying that the little work might almost be more useful to young people going into some very small business, and who had had no instruction whatever in the art, than even to schoolmasters and their pupils.

Social Economy for Children. Book II. By Ethel E. Ellis. London: Educational Supply Association.

It is not long ago since we drew our readers' attention to the former book, written and prepared by the same authoress, on this subject.

The preface tells us the principal source of the lessons is the same as that of Part I., viz., from the writings of Mr. William Ellis, and that the work has had the advantage of the supervision of Mr. James Runtz, to whom the author is 'indebted for many valuable alterations.'

We are glad to see that the different lessons are in this part headed with titles, which we consider a great improvement.

One of the chapters is on 'Attempts to Raise Wages by Force,' and very well is it done. If, may be, the present generation of working men had had such principles instilled into their minds when young, we should have had fewer strikes amongst our operatives. The preface finishes with the following: 'The subjects have been treated as much as possible from a moral point of view; the question, What ought I to do? recurring constantly in conjunction with established cause and effect. Social science may thus become the science of human well-being, showing how every one may help to bring about a state of well-being for all, while enjoying a fair share of it himself. Surely the time is come when such knowledge should be in the possession of every civilised human being.'

We gladly add that we think the authoress has thoroughly carried out her intention, and that her work ought to receive a hearty welcome in our schools.

Chambers's Geographical Readers. Standard VII. London and Edinburgh: W. and R. Chambers.

We have already noticed six of these Readers. This is the concluding volume of the series, and is equal to those which have preceded it in interest and suitability for the purpose intended. The work of Standard VII. is better calculated to exercise the thinking powers of children than the work of any previous standard, and closer application and better teaching are required more here than anywhere else in the school for this subject. A clear and interesting text-book is thus absolutely necessary, if the teaching has to be entrusted at any time to a junior assistant. Such a class-book Messrs. Chambers here present to us. In addition to the bare physical facts of the oceans, we have interesting chapters on deep-sea sounding, heaving the lead, the voyage of the *Challenger*, diving, the industries of the sea, and other suitable and correlated subjects, all treated, so far as accuracy will permit in a non-technical, popular fashion. The illustrations of the book are attractive and striking, and the use of the volume will be sure to be of service to this increasingly important standard. We do not think any teacher will regret adopting the volume.

Geometrical Drawing. By the Rev. J. H. Robson, M.A. London: Relfe Brothers.

The second edition of this volume has been re-arranged and enlarged to such an extent that it may almost be considered a new volume. It is meant principally for army students, but every student of geometry may use it with profit. It has a concise, clear, and yet sufficiently full chapter on Scales, dealing with diagonal, plain, and comparative scales, and the scale of chords in succession. Then follow chapters on the Straight Line, Triangle, Circle, Polygon, and Quadrilateral. To these are added one hundred and fifty exercises, and twenty of the latest examination papers given at Sandhurst and Woolwich. To each worked example in the chapters is added a proof or the means of proof, so that the book forms, not a mere ordinary 'rule-of-thumb' drawing-book, but an important factor of a mathematical education. The figures are well drawn, and of a good size, while the printing and binding are all that can be desired.

Analysis of the Gospel of St. John. By Lewis Hughes, B.A. London and Manchester: John Heywood.

Mr. Hughes is a practical teacher in a school which has gained great success in public examinations. The volume before us is of a practical character, divided into twelve principal chapters, with sub-sections. The subjects of the chapters and sections are printed in bold type, then follow the verses or chapters from the Authorised Version, and lastly the notes of the author. A book intended for a text-book for the University Examinations for young people is not, of course, of a controversial character; but the doctrines taught in the Gospel are treated with reverence, while objections are carefully stated where necessary, and succinct answers given.

Not one of the minutiæ so often asked in examination questions is omitted, and teachers whose pupils are expected to take this Gospel as one of their subjects of examination will find it all that they can desire. Nearly two hundred and fifty questions for examination add to its value as a class-book.

Walker's Annotated Recitation Cards. Standards II.—VI. London: Westminster School Book Depôt, 126, Horseferry Road, S.W.

These cards have all the advantages that a capital selection of pieces, good printing, stout cards, and full, accurate, and appropriate notes can give them. The only disadvantage that we can see is the size of the cards, which is inconvenient for carrying in children's bags to and from school. This is especially the case with Standard VI., where we think a double card would have been more serviceable.

Philip's Standard Map-Drawing Books. I. and II. London and Liverpool: George Philip and Son.

Messrs. Philip and Son have published these books for use in Standards III. and IV. The first contains England in three forms, Physical, Political, and Railway, with a blank projection for copying each map. The second contains Scotland and Ireland in the two forms, and the British Islands, with blank projections. In this case we think Canada and Australia would have been more serviceable, as either one or the other is needed for the yearly inspection. The maps are clear, not too ful', and are suitable for copying, but the price is greater than is usually the case with Messrs. Philip's books.

New Standard Drawing Books. A. to G. London: Cassell and Co., Limited.

These books have been prepared to meet the latest requirements for drawing. They are printed on excellent paper, each book containing twenty-four pages filled with bold examples for imitation. Of the beauty and variety of the drawings there cannot be two opinions. They are in these respects all that can be desired. We should be glad if we could stop here, but are compelled to say that they go beyond the requirements of the syllabus in so far that many of the copies, in every standard, are much more difficult than the examples in the illustrated syllabus issued by the Department. It is not always wise to be kept to the minimum requirements, but if a false standard is set up outside, the result will be a certain raising of the standard at the Department, an evil which it is necessary, in the interests of teachers and scholars, always to avoid.

'Class Subject' Drawing Copies. Six Sets. London: Educational Supply Association, Limited, 42A, Holborn Viaduct.

Six packets of cards, each containing thirty copies, printed on very good cardboards of the size required by the Department, have been published by the Educational Supply Association to meet the 'Class Subject' Drawing requirements. Five of them are freehand, and one is geometry; the latter, however, contains only geometrical figures, and does not show method of working. The examples are easy, and very carefully graduated. We should fancy, however, that it would be difficult to use them for class-teaching purposes, inasmuch as it would, from the view of expense only, be an utter impossibility to supply each child with similar copy at the same time.

Frictional Electricity. By Thomas P. Treglohan, Head Master, St. James's Science and Art Schools, Devonport. Pp. 135. London: Longmans, Green, and Co.

We took occasion, in the course of a review in last month's issue of the PRACTICAL TEACHER, to remark that it was our belief that the Science and Art Syllabus in Electricity had fallen out of date, and would remain antiquated so long as the authorities continued to lay stress upon the 'frictional' as contrasted with the so-called voltaic, or dynamical, or current phenomena. We have before us the latest development of the South Kensington scheme, and do most devoutly hope that the disease of 'satisfying the requirements of the second stage of one of the Physics courses of the "Mundella Code," as laid down by the Education Department,' is not so terribly contagious as is the disease of writing French Grammars or Short and Easy Roads to Latin; for when we had Mr. Tarn's book before us, in our March issue, and recognised, sadly, that it was but one of those whose name was Legion, we were rash enough to hope that, for half a year at least, the evil spirit was exorcised—a hope which Mr. Treglohan, not half a month later, comes forward with alacrity to dispel.

The present work is meant, in some sort, as a continuation of the author's 'Text-Book of Magnetism,' and is on the same plan. At short intervals throughout the book, series of small experiments bearing on the subject-matter previously treated are given. Very few, if any, of these demand the use of complicated apparatus, and most of them could be easily performed, if only a little amateur mechanical talent were brought to bear, at the expense of not more than a few shillings. Four or five pages are devoted to explaining the manufacture of the more recondite articles, such as the Electrophorus, Gold Leaf Electroscope, Leyden Jar, etc. The diagrams are not, many of them, new. We seem to recognise the greater part as having appeared in Messrs. Longmans' English editions of the two works of M. Ganot. As for the letterpress, it seems to us neither better nor worse than that of the host of other books which Mr. Mundella has summoned from the 'vasty deep.' The old subjects are treated in the old order. We are introduced successively to the One and Two Fluid theories, to Electroscopes, to Ice-pails, to Electrophori, to Cylinder and Plate Machines, to Œpinus' Condenser, to Torsion Balances, and end, as usual, in Thunder and Lightning. Then, as an appendix, the Examination Papers of the Science and Art Department since 1867 are given, and references are added to each question to show the enterprising student that, with Mr. Treglohan as his guide, he need fear nothing that man can do unto him.

We fear that our author has not dived very deeply into the original sources for his matter, otherwise it would be very unlikely that Sir William Thomson should always have his name wrongly spelt. Moreover, there are paragraphs which render one half afraid that some confusion exists in the author's mind; for instance, when discussing what he calls the 'Velocity of Electricity,' he makes no attempt to point out that the varying values of this quantity which he quotes, which range from 18,400 to 288,000 miles per second, are due to the fact that the experimenters were not measuring the same thing. It becomes more and more certain that the velocity of propagation of electromagnetic disturbance is practically identical with that of light, while the velocity of propagation of a spark along an interrupted wire (which is what Wheatstone and others measured) is a variable and useless quantity, which has no right at all to be called the 'velocity of electricity.' In this connection we may point out that 'the duration of the spark is considered to last $\frac{1}{11000}$ of a second' is not English. We think that, for examination purposes at all events, it would have been well to mention Nairne's name in connection with the cylinder frictional machine, with which he is usually identified, though, of course, Mr. Treglohan is quite accurate in stating that the machine is really due to Gordon, who, in conjunction with Winckler, published a complete account of the instrument in 1744, while Nairne did not produce his plans to the Royal Society till 1774.

Longman's New Readers. The Fourth Reader for Standard IV. London: Longmans, Green, and Co.

A short time ago we had occasion to notice favourably the earlier numbers of a new series of reading books, 'written to meet the requirements of the New Code of 1885,' and published by Messrs. Longmans. In the new number which has just appeared, the high character of the series is fully maintained. There is the same careful

graduation of the lessons, the same freshness and variety, the same material excellence of paper, binding, and typography. The last point is one which we have special pleasure in commending; for we do not at all agree with a comment we have recently seen made on some of the cheap popular literature which is printed with very small type, that it is on that account only suited 'for young eyes.' In view of the reports that shortsightedness and other defects of vision are increasing among young people, it would rather seem that particular care should be taken to adapt books to the use of school-children by presenting their lessons for reading and study in clear, bold type, and that young eyes especially should not be subject to the trial and strain arising from the employment of small or indistinct print.

Some of the tales of heroism and adventure included in this volume will surely prove very interesting to the children who read them; while other lessons on animals and familiar objects will supply useful information, and provide practical moral teaching in a pleasing form. Among the selected lessons are passages from Scott, Dickens, and Defoe, and poems by Mrs. Browning, Longfellow, and other modern poets. Appended to the readings are lessons and exercises in grammar, word-forming, and spelling, and a novelty at the end of the book is a 'list of words difficult of pronunciation.'

Cassell's Modern School Series. The Citizen Reader. With a Preface by the Right Hon. W. E. Forster, M.P. London: Cassell and Co., Limited.

The objects aimed at by this new reading book are such as all good citizens and patriots must approve. Setting out with the famous words of St. Paul, 'I am a citizen of no mean city,' for its motto, this book seeks 'to instruct the boys and girls in our elementary schools with regard to their rights, duties, and privileges as British citizens.' It endeavours to foster in our children a rational love of their country, and to justify in their minds the patriotic pride which would adopt St. Paul's words for their own.

We have been informed that in Sweden there are certain secondary schools, which are intended to afford special means of preparing youths of the well-to-do classes for those duties of citizenship which they will be called upon to fulfil in connection with their system of local government. In a country where the responsibilities of government are so generally shared by the people as they are in ours, especially since the last extension of political power, it seems in a high degree desirable that such instruction as the Citizen Reader supplies should be widely diffused.

The general scope of the book can be gathered from the titles of the chapters and sections, among which we find the following:—'What is Meant by being a Good Citizen,' 'Patriotism,' 'How the Country is Governed,' 'How the Laws are carried out,' 'The Navy and the Army,' 'The Flag,' 'Taxation,' 'Education,' 'Thrift,' 'Freedom.' The method in which these and other objects are treated is eminently practical, while the style is simple and straightforward, and the various lessons are relieved by many of the brave stories which light up 'our rough island story.' We have, for example, 'The Relief of Lucknow,' 'The Loss of the *Birkenhead*,' 'The Story of Khartoum,' and 'How Lancashire did its Duty.' Numerous illustrations, of a suitable kind, add to the interest and attractiveness of the volume.

Prominent among the merits of a work like this, must be reckoned its freedom from anything like party-bias; and, after our examination of its contents, we can cordially endorse the opinion of the eminent educationist and statesman who has written the preface, 'that there is little, if anything, in this book which will not be accepted by men of all creeds and parties.' We would add that it would be scarcely possible for any one to read this book without having his knowledge improved and his better feelings stimulated.

A Manual of the English Grammar and Language for Self-Help. By Lucy Toulmin Smith. London: Ward, Lock, and Co.

As stated in the preface, this work is reprinted from *The Universal Instructor*, a serial publication issued by the same publishing firm. It includes a very large amount of information which will not only prove useful to the student, but which is made interesting. The complaint so often heard, that grammar is a dry subject, arises mainly from the fact that in so many works it is presented as a mass of mere rules and forms. A living language, when taught as a matter of accidence merely, is almost like a dead one. Miss Toulmin Smith gives a full account of the accidence, the classification and inflexion of words; but she also dwells on the history, the changes, the growth of our mother-tongue, and she does this in such a manner as to prove herself somewhat of an enthusiast in the subject, and so the more likely to rouse the student to earnestness. We regard this as a merit in a book for self-help; but connected with it—probably springing from it—is a fault which betrays itself in much of the explanatory writing. This fault is looseness of style. For example, on the first page of the introductory chapter we find—'Is it not a shame to many of us, our ignorance of this valuable and beautiful instrument by which we carry on our daily intercourse?' Again, on page 3,—'The value of the study of English Grammar (in its extended sense—see next section) may be said to be threefold.' And, speaking of Chaucer,—'Thus, though that sweet "well of English undefiled" cannot lay claim to be the father of our poetry, as he is sometimes mistakenly called, he may fairly be considered as the great appointer of our tongue.' Other examples of longer sentences might be given, in which an excessive use of the parenthesis and dash, and a peculiar employment of other marks of punctuation, tend to obscure the sense, and detract from the merit of the book. Apart from this point which we have ventured to criticise, the work seems well adapted to serve its purpose. Free use has been made of the works of Dr. Richard Morris, Dr. Marsh, and other leading authorities on the history and grammar of our language.

Healthful Exercises for Girls. By A. Alexander. London: George Philip and Son.

The Director of the Liverpool Gymnasium has in this book collected and arranged a great variety of physical exercises, which, he tells us, are those at present in use in the institution under his direction. We have also the assurance that 'each movement has been carefully adapted for the bodily training of girls, and in every case has received the approval of high medical authority.'

The exercises are given in sixteen sections. The first series, under the name Calisthenics, includes a number of movements without apparatus, and these can be used where space and expense have to be carefully considered. Several of the following sections consist of exercises for which light and simple apparatus are required, such as wooden dumb-bells, French bar-bells, calisthenic rings, and sceptres. The author recommends that the wooden dumb-bells used for these exercises should weigh less than two pounds per pair, and on no account more. He suggests that common broom-handles may be used for the French bar-bells. The exercises with the sceptres are somewhat similar to those performed with Indian clubs.

Following the movements with simple apparatus is a course of swimming drill, which is recommended as a help to acquire the art of swimming, and also for the healthful character of the exercises. Further sections are devoted to exercises with more complicated apparatus, such as the chest machine, the spinal ladder, the curvature wheel, the tram-cushion, railway ropes. Many of these are recommended as beneficial in particular forms of spinal or other bodily weakness; though a caution is added that some exercises should only be used under the direction and advice of a competent instructor. Every exercise is de-

scribed in a simple way, and clearly illustrated by small figures drawn by Miss Gisborne, a member of the ladies' class at the Liverpool Gymnasium. The work appears to be thoroughly worthy of adoption in the higher schools for girls; and teachers of elementary schools would find it possible to select many exercises which they could turn to good account, not only in girls', but also in boys' schools. The long experience of the author enables him to say that in the majority of cases a course of gymnastic exercises is only adopted, on medical advice, as a means of remedying some physical deformity, and too often the remedy is delayed till cure becomes impossible; whereas the early adoption of such exercises would lessen the danger of such bodily weakness, and frequently check or prevent its development.

Diagrams and Instructions for Collective Teaching: An Introduction to the Drawing of Certain Curvilinear Forms and Polygons. By J. A. Hammersley. London: Thomas Laurie.

Elementary Freehand Drawing Copies for the First Grade. By the Rev. Canon Richson, M.A. Fourth Edition. Twelve numbers. London: Thomas Laurie.

The first-mentioned of these works is intended as introductory to the second. It consists of some forty exercises with instructions, mounted on twenty stout cards, the figures being distinct enough to be seen by a class of forty or fifty children. The exercises begin with vertical and horizontal lines, and are very gently graduated to the drawing of a square, a rhombus, and then to more difficult figures, such as polygons and ellipses. The drawing is intended to be done throughout without instruments, but the geometrical character and construction of the figures is to be constantly kept in mind. These copies may be found very serviceable in teaching drawing as a class-subject in the lower standards.

In preparing the series of Elementary Freehand Drawing Copies, Canon Richson was assisted by Mr. Hammersley, Mr. George Wallis, Mr. Slocombe, and Mr. Burchett, all well-known teachers in Schools of Art.

The principle on which the course of instruction is based is thus stated:—'The only safe and certain method of educating the eye to a perception of form, and the hand to an obedient power of reproducing objects as perceived, is through a course of instruction in exact or geometric forms, and proceeds thence to the drawing of familiar objects devoid of perspective foreshortenings or in *elevation*.' It is urged that drawing first from familiar forms, not uniform or symmetrical, encourages a capriciousness of impression which requires to be corrected. The copies are graduated in accordance with this principle, and are of very varied character. In the higher numbers the exercises appear to be quite as complicated as those usually given for second-grade candidates.

An Analysis and Study of the Leading Characters of 'Hamlet.' By 'Oxon.' London: Swan Sonnenschein, Le Bas, and Lowrey.

In this little volume, which is dedicated 'by special permission to Henry Irving, our greatest living actor,' is a praiseworthy attempt to unravel the character of Hamlet, a character which, to philosophical students of Shakespeare, has proved perhaps the most puzzling of all those delineated in his plays. Those who wish to get at the real essence and meaning of the wonderful tragedy will here find abundance of material to help them in arriving at a conclusion. This material is very methodically arranged, and the various points brought forward are tersely stated, and amply illustrated, where necessary, by quotations.

The book opens with this general statement:—

'Hamlet is a noble, generous, high-souled, and brave man. He has all the accomplishments, education, and refinement of a gentleman; and is a prince, not merely by rank, but also by reason of his nobleness of character. But all these ornamental qualities are not enough to make the Hamlet of this play. There are more qualities needed to make up the part of our hero. These are—tenderness and devotion, remarkable insight and ability shown both in thought and word, love of truth, dashing energy and courage, and, above all, self-control and uncomplaining self-sacrifice.'

These elements of character—his nobility, his energy and courage, his self-control, his self-sacrifice, and his intellectual power—are then dwelt upon in detail. On doubtful matters, such as the much-disputed question of Hamlet's madness, the evidence on both sides is fairly stated. Thus we have eighteen medical and nine general arguments in favour of the opinion that Hamlet was really mad, and on the other side we have seventeen reasons for considering him sane throughout. The arguments, however, do not appear to be all independent or mutually exclusive; some are rather re-statements of others.

On the point that no medical evidence is forthcoming in favour of Hamlet's sanity, the author says: 'Probably this is due to the fact that insanity specialists, *alias* mad doctors, are much better at detecting traces of insanity than sanity. In fact, it pays better to prove a person to be mad than to prove him to be sane—*exceptâ Mrs. Weldon.*' In adding the last phrase, perhaps 'Oxon' rather forgets his dignity.

The difficulties of Hamlet's position and the defects of his character are noted and exemplified, and then follow, in the form of a series of quotations from other writers, twenty suggestions as to the key to Hamlet. 'But for all these suggestions,' says the writer, 'we cannot consider the Hamlet question settled yet, and we bid adieu to commentators and would-be solvers in the words of Tennyson:—

> "Thou hast not gained a real height,
> Thou art not nearer to the light,
> Because the scale is infinite."'

The characters of Ophelia, the Queen, Polonius, Laertes, Horatio, and the King are dealt with in a similar manner, but more briefly. Altogether this little book is deeply interesting; and, though it would, of course, be better, if possible, that each student should make such an analysis for himself, we know that the ordinary conditions of study make this impossible in the vast majority of cases; and so the publication is one we sincerely welcome as likely to assist the rational study of our great dramatist.

It appears that the author has already published similar analyses of 'Macbeth' and 'As You Like It,' that he has six others ready for publication, and that he proposes to complete an exhaustive work on all the leading characters of all Shakespeare's plays if he should meet with the encouragement of public favour.

An Etymological Index to Shakespeare's Play of 'Julius Cæsar.' By F. C. Woodforde, B.A. London: Simpkin, Marshall, and Co.

This is a very different book from the one we have just noticed. It concerns itself rather with the letter than the spirit of Shakespeare's play. It is, in fact, an alphabetical glossary of the important words occurring in 'Julius Cæsar,' and an additional list of the proper names, with a statement of the facts associated with them. As the Syndicate on the Cambridge Local Examinations has complained that the papers of candidates show imperfect knowledge of derivations and peculiar uses of words, it is thought that this glossary may prove useful in remedying the defect. For the most part, the work attempted appears to be well done; but to say that 'adder' is drived from A.S. nœdre, a snake, seems a very insufficient account of the derivation of this word, which affords an opportunity of explaining the peculiar change caused by disjoining the initial *n* from the noun and adding it to the article—a nœdre=an adder, a change further illustrated in the words *orange* and *apron*.

'Lief,' in the line 'I had lief not be,' etc., is not well-explained as equivalent to 'dear, beloved, pleasing'; no

is 'light,' in the sentence 'now some 'light,' equivalent to discernment' as well as to 'alight.' In some cases where the meaning only is given, the addition of the etymology would not only explain the word more clearly, but would give new interest to it. In spite, however, of some shortcomings, the work contains some useful and desirable information not usually found in the annotated editions published for school use.

Blackie's School Classics. Selections from 'Henry VIII.' and 'Julius Cæsar.' Selections from 'Richard II.' and 'Henry IV., Part II.' Shakespeare. London: Blackie and Co.

Each of these little books contains half-a-dozen scenes selected from the plays named. Each scene is introduced by a short and simple statement of the circumstances which lead up to it. At the foot of each page appear brief but ample explanatory notes suitable for school children. The selections are reprinted, we believe, from an excellent reading-book called 'The Shakespeare Reader,' produced a few years ago by the same publishers. Where that book is used in class, these little books would admirably serve the purpose of home study and special preparation for the requirements of the New Code in the class-subject, English.

An Elementary Treatise on Physical Geography. London: Blackie and Son.

This handbook of forty-eight pages is adapted to meet the requirements of the Education Code for Scotland, and is further intended for use in public schools. The author naïvely suggests that his work is not intended for Fellows of the Royal Geographical Society. It does not follow, however, that the material of these pages is not of a scientific character. We congratulate the author upon presenting the chief phenomena of physical geography in simple and, for the most part, correct statement.

Suggestions for improvement are requested in the preface. We make one—viz., that along with the written statements there should be a much more abundant supply of diagrammatic and pictorial illustration.

Photo-Relief Map of Scotland. By Henry F. Brion and Rev. E. McClure, M.A. London: S.P.C.K.

We hail with unmixed pleasure this instalment of a new series of photo-relief maps. Abundance of material is at hand in the magnificent results obtained by the Ordnance Survey for the cartographer to rescue English geography from the ignoble position it now holds respecting maps for teaching purposes. The display of maps from Belgian, French, and German schools, made first at the Health Exhibition, and repeated at the recent Exhibition under the direction of the Royal Geographical Society, has awakened a demand for maps which are not mere plans, but which, whilst recording the relative positions of geographical facts, exhibit, at the same time, by the skilful arrangement of light and shade, the contour of hill and valley in their natural grouping. We trust the series of photo-relief maps now issued will be followed by a series of wall-maps suitable for wall decoration and for class instruction.

The Principles and Practice of Teaching. A Manual of Method for Pupil Teachers and Assistant-Masters. By A. Park, F.R.G.S., F.E.I.S. London: Blackie and Son.

The connection between Science and School Method is not yet fully realised. The mental philosopher approaches the discussion armed with the generalized truths of his science. He is, however, not sufficiently familiar with the details of the teaching art to enable him to establish trustworthy connections between the various devices of the teacher and the abstract truths of mental science. Mr. Park approaches the discussion from the standpoint of the successful teacher. He knows well the art of teaching. His methods of teaching are sound. Further, he has evidently consulted a formidable array of philosophical works, and from these he has extracted two-thirds of the matter dealing with:—(*a*) *The training of the senses and the memory.* (*b*) *The order in which the faculties of children should be developed; and* (*c*) *The reasoning processes.*

The chief authorities from whose works copious extracts have been taken are Sully, Bain, Sir W. Hamilton, Professor Brown, Dr. Reid, Diderot, Dr. Bernstein, Locke, Dr. Abercrombie, Dr. Carpenter, Dr. Combe, Donaldson, Mansel, and Kant. These represent various schools of psychological thought, and the massing of matter collected from this wide area has resulted in a variety of opinion and statement which must prove bewildering to the learner, be he pupil teacher, assistant, or student. Examine, for instance, the paragraphs on 'Modes of Mental Action' (p. 12). According to our author:—

1. 'Bain distinguishes three properties of mental (*sic*) action —(*a*) Discrimination, (*b*) Retentiveness, (*c*) Detection of similarity.'
2. 'Sully also adopts a three-fold division, but differing very materially from the method followed by Prof. Bain— (*a*) The Intellectual Faculties, (*b*) The Feeling, or Emotional, (*c*) The Willing.'

Now, if the author will refer again to these authorities, he will see that they do not disagree in the manner he describes. Bain simply states the threefold division of INTELLECT, whilst Sully states that Intellect is one of the three groups into which ALL MENTAL PHENOMENA can be divided. Bain is treating of one third of mind only, whilst Sully of the whole of mind.

3. Mr. Park then suggests what he terms a *good working division* of the principal modes of mental action. It is as follows:—(*a*) Sensation, (*b*) Perception, (*c*) Conception, (*d*) Attention, (*e*) Memory, (*f*) Imagination, (*g*) Reason, (*h*) Judgment, (*i*) Reflection.

The numbering suggests a careful arrangement of the various intellectual operations, but surely 'conception' and 'judgment' are out of natural order. We give the following arrangement:—(*a*) Sensation, (*b*) Perception, (*c*) Memory, (*d*) Imagination, (*e*) Conception, (*f*) Judgment, (*g*) Reasoning.

4. The intellectual operations enumerated above are then grouped under the following three heads:—(*a*) The External Senses, (*b*) The Internal Senses or Perceptive Faculties, and (*c*) The Reflective Faculties —a grouping which, Mr. Park states, is somewhat antiquated, and we agree with him.

Let us ask ourselves what arrangement of mental phenomena any student striving after light is likely to adopt, after contact with these four distinct groupings, all of which are brought within the compass of two pages of text. There must, necessarily, be considerable confusion. If he follow the author's arrangement he will find number *three* to be illogical and number *four* old-fashioned.

Besides the variety of opinion and statement which necessarily results from a gathering of extracts from so many sources, there is much collected that is entirely beyond the capacity of the average student. We select the following from one page:—

1. Speaking of Hypothesis, the following is inserted from Sully:—'This is one of the highest manifestations of the constructive or synthetic activity of mind.'
2. *Inference.*—'An inference is a conclusion arrived at from a premiss in reasoning. The previous judgment, however, recurs rather as an afterthought, and by the suggestive force of the similarity between the new case and the old.'
3. *Proof.*—When 'a distinct reference is made,' in the process of our reasoning, 'to some antecedent judgment' on which our inference depends, and 'forms a part of our concluding revisional process,' then we characterise that as a 'process of proof.'

Now, neither pupil teachers nor assistants are likely to be attracted to the examination of mental processes by such profound and indigestible statements as these. They will rather be alienated from the study of Logic and Psychology, and prefer to remain in the region of those empirical methods which have yielded satisfactory results,

even though the scientific bases upon which they rest continue a mystery.

Britannia and her Daughters. A Cantata. By T. Mee Pattison. London: Curwen.

The libretto of this cantata is from the pen of Mr. A. J. Foxwell, who has already achieved much success in this department of literary work. The music is generally easy and effective, and though arranged in four parts (S.A.T.B.) it may be readily adapted for school use.

As a whole, the work is one of considerable merit, and the introduction of typical Indian, negro, and other native melodies, adds to the interest and gives colour to the music.

Freddy and his Fiddle. A Children's Operetta. By A. J. Foxwell and T. M. Pattison. London: Curwen.

An old Norse legend supplies the material for the libretto, and the present arrangement for school use cannot fail to ensure success. Freddy's adventures, vicissitudes, and final triumphs will be fully appreciated by the children, and they will certainly take to the work *con amore*. The music is pleasing and melodious, and is not beyond the reach of average schools. We commend Mr. Pattison's compositions to the attention of teachers.

Santa Claus at the School. A Christmas Cantata. By W. H. Doane. London: Curwen.

Mr. Doane's cantata contains much bright and tuneful melody of the popular American type, and being easy and not over-extended in compass it will present no difficulty to ordinary school-children.

There are occasional slips in the harmony (*e.g.*, the consecutive octaves between alto and bass, page 2), but the work, as a whole, is eminently suitable for school use.

Handbook of Musical Biography. By C. A. Caspar and E. M. Patmore. London: Bell and Sons, Covent Garden.

This little work is intended for general readers and schools, being 'specially designed for the use of young people.' The study of musical biography is rapidly extending in this country, and there is a large demand for dictionaries and histories of music and musicians. The handbook before us is very readable and is clearly arranged.

Such a small work comprises of necessity only a limited number of names, still we are surprised to find no mention of the Early Flemish School, and no notice of Monteverde, the two Scarlattis, Corelli, Clementi, and some others.

The Key Modulator. By John Taylor. London: George Philip and Son.

Mr. Taylor claims that his system is 'based consistently, *and for the first time*, upon the paramount law of the relation of musical sounds.' We cannot see, however, how this claim can be substantiated, as the 'movable doh' system, applied to the staff notation, has been in vogue in this country for many years past, and Mr. Wareham introduced a Staff Notation Modulator a few years ago, which seems to us to be identical in principle with the one before us, though differing somewhat in its application.

We may say also, for the benefit of our tonic sol-fa readers, that the flat of *doh* is *du* or *duh*, not *da*.

The Little Primer. (Royal School Series.) London: T. Nelson and Sons.

This little Primer is a little gem—in fact, it is an ideal book for babies, and richly merits an extensive circulation. Without a doubt it is the best pennyworth of its kind we have ever seen.

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